NEW TEACHER PBL PLANNING AND IMPLEMENTATION

Marlon K. Harris

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APPROVED:

Karthigeyan Subramaniam, Chair
Pamela Harrell, Co-Chair
Ruthanne Thompson, Committee Member
Chris Long, Committee Member
Misty Sailors, Chair of the Department of Teacher Education and Administration
Randy Bomer, Dean of the College of Education
Victor Prybutok, Dean of the Toulouse Graduate School

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This study investigated novice science and mathematics teachers' beliefs about planning and implementation of project-based instruction. Data for this qualitative study included two focus groups and a questionnaire. Items in the questionnaire were designed using preliminary findings from the analysis of the two focus groups, and from predefined items from the National Survey of Project Based Learning and High School Reform. The questionnaire was administered to 138 novice secondary mathematics and science teachers certified in their respective content areas. The respondent rate was 70% (n = 96). Of the 96 respondents only 28 participants utilized project-based instruction. Data analysis revealed that the 28 participants held two specific beliefs about project-based instruction. First, participants believed that the implementation and enactment of PBL: (a) made student learning more personalized by specifically meeting the individual interests or needs of students; (b) promoted students' international or cross-cultural understanding; (c) promoted students' civic engagement and contributions to the community or world; and (d) impacted high-achieving students ability levels. Second, participants believed that the implementation and enactment of PBL: (a) made teaching and learning more varied, challenging, or fun; (b) taught skills beyond academic content; and (c) taught academic content knowledge and skills more effectively. These two beliefs were situated within contexts where the instructional strategy most often used to deliver content was direct instruction and by external factors that impacted the participants' utilization and implementation of PBL. External factors included: testing and accountability requirements; a lack of time for planning and implementation of PBL lessons; students' lack of experience or skills associated with enactment of PBL; large class sizes; limited classroom space; and poor attendance.

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CHAPTER 1

INTRODUCTION

Introduction/Background

There has been varying opinions on the impact project- or problem-based learning (PBL) has on student performance. Research has shown there was no difference in test scores between PBL students and traditional students at the undergraduate level (Alessio, 2004). Alessio's research also indicated there was a preference to the traditional means of instruction as opposed to the student-centered PBL instruction based on student responses. Research was also conducted that yielded results displaying students' displeasure with PBL instruction (Lewis et al., 2009). Undergraduate student data suggests there was a lack of clear expectations from the faculty, student lead group sessions were unclear, and there was a lack of opportunity to explore personal academic interests (Lewis, et. al, 2009).

Alternatively, research has also shown that PBL is an effective mode of instruction for undergraduate students based on assessment data. For example, non-science majors taking a biology course displayed significantly improved post-test scores when utilizing PBL and service learning components (Tawfik et al., 2013). PBL has also been shown to increase motivation and perception of students. Seventy-five percent of undergraduate students enrolled in an analytical chemistry course believed they worked more carefully than in a traditional laboratory format (Robinson, 2013). The varying results from researchers provides a reasoning to analyze the effectiveness of the practices and how they are implemented in today's classrooms. The area that needs to be addressed or explored is "teachers' beliefs regarding PBL and do these beliefs impact the planning and eventual implementation of PBL strategies during instruction".

Based on the aforementioned research, several local universities (including UNT) have

adopted courses for preservice teachers based on PBL instruction. These courses are prescribed to education majors and focus on project-based and problem-based learning (brief description of once course is found in the appendix). As universities employ these practices based on the PBL concept, it is significant to understand the teachers' perspective regarding planning and implementation of PBL lessons once they become the teacher of record. Teachers that perceive themselves as facilitators prefer PBL as their primary means of instruction (Habók, 2016). Research has also shown an increase in pre-service teaches perception of their ability to effectively teach science through the use of PBL after undergoing an authentic PBL experience (Pepper, 2013). Habok and Nagy (2016) revisited the concept and focused their research on teachers' perceptions of project-based learning and found that elementary teachers prefer to utilize PBL type methods whereas secondary teachers prefer to utilize more frontal work (p. 96). The authors described frontal work as individual work and demonstrations. The distinction between the two levels (elementary and secondary) provide insight on teachers' beliefs and the impact those beliefs have on instruction.

Statement of the Problem

Analyzing the impact PBL course instruction has on the actual transfer of practices to the classroom would provide researchers and practitioners with a working blueprint to better understand effective PBL instruction. Research has shown that PBL methods could be beneficial to preservice teachers' content knowledge and increased knowledge of pedagogical techniques. (Ertmer et al., 2014). Problem-based learning has also demonstrated an increase in preservice teachers' perception of their confidence, self-efficacy, and problem-solving (Pepper, 2013; Park & Ertmer, 2008; Ochoa et al., 2004). Despite an increase in the knowledge base created from the experience preservice teachers gained by participating in PBL based instruction, there are still

questions regarding the actual planning and implementation in the classroom. According to So and Kim (2009), "this study shows that while student teachers had a good understanding of pedagogical knowledge on PBL, they experienced several difficulties applying their knowledge in designing a PBL based, technology integrated lesson" (p.111). Based on the literature there is a pellucid distinction that additional research is required in order to obtain a better understanding of how the positive experiences acquired in the university classrooms can be transferred to the public K thorugh12 classrooms. Analyzing "if" teachers are actually implementing the practices acquired at the university could also lead into future research about "why" based on the results of this research.

Framework for the Study

The primary focus of project-based Learning is the planning and manufacturing or constructing of a "product." Based on this notion of constructing a product, this study will situate project based learning within constructivist learning theory. Krajcik and Blumenfeld (2006) describe constructivism in the following sentences:

> Deep understanding occurs when a learner actively constructs meaning based on his or her experiences and interactions in the world, and that only superficial learning occurs when learners passively take in information transmitted from a teacher, a computer, or a book. The development of understanding is a continuous process that requires students to construct and reconstruct what they know from new experiences and ideas, and prior knowledge and experiences (p.318).

The main concept is the actual constructing of meaning. Meaning is constructed based on our experiences and our interpretation of certain phenomena. Every student arrives with their own personal experiences, biases, and beliefs which impact how that student views the world. Collectively, constructivists understand the significance and the uniqueness of our ability to make meaning from our experiences. This uniqueness is a key attribute that separates man from the rest of the organic organisms that inhabit our planet. Constructing meaning varies from

individual to individual. Two students can be asked to develop projects based on the same scenario and construct two entirely different projects.

The two forms of constructivism positioned in this research are cognitive and social constructivism. Cognitive constructivism is a collection of psychological and epistemological theories centered on knowledge construction through an individual's mental processes. Cognitive constructivists focus on how meaning is constructed by the individual. As stated earlier, these constructs differ from person-to-person based on personal experiences. One of the pioneering cognitive constructivists was Frederick Bartlett. In his research utilizing Native-American fables, Bartlett (1932) found prior knowledge to be significant in the subjects' knowledge construction. Bartlett's findings expanded on Kant's earlier findings in that he viewed the structures and methods in which knowledge was organized as more complex than Kant's categories. A more well-known cognitive constructivist is Jean Piaget. Piaget's impact on constructivism is based on his well-known theory of cognitive development. Piaget's theory of cognitive development explained how children's schémas are constructed through the process of assimilation and accommodation, when going through four different stages of development (Wadsworth, 2004). The four stages of cognitive development are: sensorimotor stage, preoperational stage, concrete operational stage, and formal operation stage.

Social constructivism and cognitive constructivism both play a significant role in project based learning. As evident in one of the founders of project based learning, Kilpatrick's explanation of the purposeful act aligns with concepts associated with project based instruction. Kilpatrick was a student of John Dewey and despite his initial hesitance to subscribe to his philosophy, he eventually embedded many of Dewey's ideologies into his 'Project Method' (Beineke, 1998). According to Kilpatrick (1918), "the purpose thus supplies the motive power,

makes available inner resources, guides the process to its preconceived end, and by this satisfying success fixes in the boy's mind and character the successful steps as part and parcel of one whole" (p.4). He describes the inner resources as knowledge and thought in the possession of the individual. Kilpatrick thought the emphasis should be placed on the experiences and knowledge the student brings to the subject matter, not just what the subject matter brought to the student. (Beinke, 1998). It is interesting to see that Dewey, Kilpatrick, and other researchers were interested in a more student project approach in education nearly 100 years ago, and we are still discussing whether this approach is viable. The significance of constructing meaning through the utilization of prior knowledge is evident in PjBL. The beginning phases of the projects generally begin with students identifying the problem and assessing their preexisting knowledge of the problem as well as what they need to know in order to solve the problem. (Hallerman, et al., 2011)

If the students are instructed to work in groups, we must include the social constructive lens to analyze characteristics of PBL instruction. According to Anderman and Dawson (2011), "social cognitive theorists examine the interaction between the learner, the environment, and others" (p. 224). The environment described by Anderman and Dawson can be interpreted as the entire classroom in a PBL setting. The others would refer to other members of the immediate group. Social constructivism emphasizes the role that social and cultural interactions have on the learning process. According to Vygotsky, "Every function in the child's cultural development appears twice: first, on the social level and, later on, on the individual level." (p. 57). Known for his construction of the zone of proximal development, Vygotsky is a key contributor to the social constructivist's pedagogy. Understanding the significance of the social environment is also a key concept in PjBL. Purposeful engagement in a social environment best guarantees the

utilization of the child's native capacities (Kilpatrick, 1918). Information is shared in a collaborative fashion when students engage in project-based learning activities. Collaboration and effective communication are key traits in PjBL (Hallerman, et al., 2011). As all of the skills mentioned are utilized to solve a problem or explain a phenomenon, we must acknowledge the social interaction which facilitates this construction of meaning.

Purpose of the Study

The purpose of this study is to examine teacher's beliefs regarding PBL. Teachers' beliefs will be examined during their planning and implementation phases in the lesson cycle. The study assumes teachers have sufficient knowledge and expertise regarding PBL, thus the unit of analysis is the teacher perception data. The research should provide researchers and practitioners with knowledge to improve pedagogical processes that can be implemented at the collegiate level and transfer to the classroom.

Research Questions

The specific research questions to be addressed by this study are:

RQ1: What are novice teachers' beliefs about PBL while planning a lesson or unit?

RQ2: What are novice teachers' beliefs about implementing PBL lessons and/or units in their classroom?

Definition of Terms

Definitions of terms for the purpose of this study are provided following a brief analysis that distinguishes the difference between problem-based learning and project-based learning. While there are numerous terms discovered in the literature related to teachers' perceptions and beliefs about PBL, the definitions here are those that are central to the study.

Problem-Based or Project-Based

Student learning has been the focal point of education since its formal conception. From the beginning, comprehending transfer of knowledge from teacher to student has been at the forefront of education. This notion of knowledge transfer can be traced back to ancient civilizations and cultures, however the Greeks are given credit for the concept of student reflection or inquiry. According to Loyens and Rikers (2011), "learning is propelled by the process of inquiry, which allows students to become more familiar with particular subject matter that is introduced in the presented situation" (p. 365). Reflecting, critical thinking, analyzing, problem-solving, and communicating are the basic skills necessary to effectively navigate in an inquiry based curriculum. These skills will be reviewed and analyzed as two types of inquiry-based instruction: project-based learning and problem-based learning, are defined, differentiated, and discussed.

The purpose of this section is to define, differentiate, and discuss problem-based learning as compared to project-based learning. Both methods of instruction require students to be actively engaged in the content by exploring and communicating. Problem-based learning is often used in conjunction or interchangeably with project based learning and both are described with the same abbreviation (PBL). In order to establish clarity, PBL describes problem based learning and PjBL is used to describe project based learning (Loyens, S. & Rikers, R. 2011). Distinguishing the difference between these two pedagogies is vital in understanding the theoretical framework from which project-based learning is derived. PBL was introduced to a cohort of twenty undergraduate students in the undergraduate MD program of McMaster University in 1969 (Neville & Normal, 2007). Ten years later, the University of New Mexico became the first medical school in the United States to offer a PBL curriculum (Donner &

Brickley, 1993). The Medical school students appeared to struggle with connecting factual information received their first few years to skills required during the residency (Walker & Leary, 2009). Collectively the students were not successful in implementing the content gained with the necessary medical practices. PBL was designed to address the disconnection between the content and the application of medical practices.

Problem-Based Learning (PBL)

According to Barrel, (2007), "PBL (problem-based learning) can be defined as an inquiry process that resolves questions, curiosities, doubts, and uncertainties about complex phenomena in life" (p. 3). Savery (2006) defined PBL as "an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem" (p. 2). Regardless of which definition is utilized, the process involves incorporating the following skills: reflecting, critical thinking, analyzing, problem-solving, and communicating. The utilization of these skills in a collective effort to solve a problem or complex phenomena usually regarding real life is a key component of the PBL curricula. There are several methods of implementing problem-based learning, but in order to establish clarity on the process, this study will focus on the model utilized by Barrows. Barrows (1996) concluded there are certain characteristics that have to be evident in utilizing a PBL curriculum and process. These characteristics are: (1) Learning is student-centered, (2) Learning occurs in small student groups, (3) Teachers are facilitators or guides (4) Problems form the organizing focus and stimulus for learning, (5) Problems are a vehicle for the development of clinical problem-solving skills, and (6) New information is acquired through self-directed learning. (p. 6) Barrows found these six characteristics vital in

any attempt to implement a PBL program. In PBL, students usually adhere to specific or prescribed steps when solving the problem.

Project-Based Learning (PjBL)

Project based learning is an extensive didactic approach to engage students in continuous collaborative investigations (Bransford & Stein, 1993). Project-based learning was pioneered by William Heard Kilpatrick, a student of John Dewey. Despite his initial hesitance to subscribe to his philosophy, he eventually embedded many of Dewey's ideologies in his project method (Beineke, 1998). Kilpatrick's project method began while observing students during free play at the Horace Mann playground and required more than a year to develop. (Beineke, 1998). His observations of students freely playing and selecting the activities of their choice inspired Kilpatrick to focus on the significance of the purpose in projects. Kilpatrick identified different types of projects and established a clear explanation of each type of project. Kilpatrick (1918) best explains each of the types of projects in the following:

> Type 1, where the purpose is to embody some idea or plan in external form, as building a boat, writing a letter, presenting a play: Type 2, where the purpose is to enjoy some (esthetic) experience, as listening to a story, hearing a symphony, appreciating a picture; Type 3, where the purpose is to straighten out some intellectual difficulty, to solve some problem, as to find out whether or not dew falls, to ascertain how New York outgrew Philadelphia; Type 4, where the purpose is to obtain some item or degree of skill or knowledge, as learning to write grade 14 on the Thorndike Scale, learning the irregular verbs in French. (p. 4)

Regardless of the type of project, Kilpatrick contends that the student has to perform a purposeful act in order for the project method to be effective. According to Kilpatrick (1918), "it is to this purposeful act with the emphasis on the word purpose that I myself apply the term "project" (p. 2)". More recent research also found the significance of projects or products when engaging students in project-based learning. According to Blumfield et al. (1991),

> There are two essential components of projects: They require a question or problem that serves to organize and drive activities; and these activities result in a series of artifacts, or products, that culminate in a final product that addresses the driving questions (p. 371).

Despite their similarities, these two pedagogies differ in that PjBL usually consists of a wider range of learning activities and end products (Loyens & Rikers, 2011). The following diagram furnished by the Buck Institute for Education (BIE) website best summarizes the similarities and differences between project-based learning and problem-based learning.

Table 1

Project Based Learning vs. Problem Based Learning

Project Based Learning vs. Problem Based Learning	
Similarities	
Both PBLs: • Focus on an open-ended question or task • Provide authentic applications of content and skills • Build 21st century 4 C's competencies • Emphasize student independence and inquiry • Are longer and more multifaceted than traditional lessons or assignments	
Differences	
Project Based Learning	**Problem Based Learning**
Often multi-disciplinary	More often single-subject
May be lengthy (weeks or months)	Tend to be shorter
Follows general, variously-named steps	Follows specific, traditionally prescribed steps
Includes the creation of a product or performance	The "product" may simply be a proposed solution, expressed in writing or in an oral presentation
Often involves real-world, fully authentic tasks and settings	More often uses case studies or fictitious scenarios as "ill-structured problems"

As illustrated in Table 1, there are several aspects in which both methods are similar. However, the diagram also summarizes the differences that exists in these two pedagogies.

Similarities

According to Table 1, both instructional methods: focus on an open-ended question or task, provide authentic applications of content and skills, build 21st century 4 C's competencies (communication, collaboration, critical thinking, and creativity), emphasize student independence and inquiry, and are longer and more multifaceted than traditional lessons or assignments (Larmer, 2013). The above similarities in characteristics contribute the merging or not distinguishing the difference between these two pedagogies. The principles of learning are very similar and permit for a logical merging of the two (de Graaff & Kilmos, 2007). Despite possessing similarities that would mislead an individual to conclude they interchangeable, there are also some noticeable differences.

Differences

The illustration clearly establishes differences between the two pedagogies. The most noticeable difference is the situation of the problem. PjBL is situated in real-world experiences and PBL is often situated in case studies and fictitious scenarios. Another noticeable difference is PjBL incorporates multiple disciplines while PBL is usually associated with one content area. An everyday example would be a PjBL lesson which incorporates math and science with a focus on a "product" being designed and manufactured while a PBL lesson would consist primarily of solving a problem associated with one of the disciplines. The last difference that will be discussed is the duration of the lesson. According to the BIE website, PjBL activities are usually longer in duration than PBL. The basic differences described provide possible researchers clarity

regarding the general misconception that problem-based learning and project-based learning are synonymous and could be used interchangeably.

Conclusion

With connections tracing back to John Dewey and his philosophy or vision that students learn by doing, the number of students gaining experience with a project-based learning curriculum and the processes associated with it are increasing. We can understand the impact the medical schools had in developing problem-based learning and how it has migrated to public schools. Despite their polarizing differences in origin, it is evident that reflecting, critical thinking, analyzing, problem-solving, and communicating are the basic skills necessary to effectively navigate in either pedagogy. In this study project-based learning and problem-based learning are clearly defined, the differences between problem-based learning and project-based learning are distinguished. Establishing this background is vital in examining pre-service teachers' beliefs regarding project-based instruction.

Definition of Other Terms

- *Cognitive experience* is "one which has certain bearings or implications which induce and fulfill themselves in a subsequent experience in which the relevant thing is experienced as cognized, as a known object, and is thereby transformed or reorganized (p.162)" (Bhode, 1905)
- *Constructivism* is a doctrine stating that learning takes place in contexts and that learners form or construct much of what they learn and understand as a function of their experiences in situations (Zimerman and Schunk, 2008).
- *Environmental settings* refers to both the physical, or constructed surroundings to the affective environment created by the interaction of the educator, the individual learner, the group of learners, the content, and the physical environment (Heimlich, 1993).

- *Inquiry-based instruction* is propelled by the process of inquiry, which allows students to become familiar with particular subject matter that is introduced in the presented situation, but also learn more about the inquiry process itself (Loyens & Rikers, 2011).
- *PBL* is an inquiry process that resolves questions, curiosities, doubts, and uncertainties about complex phenomena in life (Barell, 2007).
- *PBL facilitator* is an expert learner that is able to model good strategies for learning and thinking, rather than providing expertise in specific content (Hmelo-Silver & Barrows, 2006).
- *PBL implementation* is the enactment of PBL teaching and learning processes.
- *PjBL* is a form of situated learning and it is based on the constructivist finding that students gain a deeper understanding of material when they actively construct their understanding by working with and using ideas (Krajcik & Blumenfield, 2006).
- *Teacher beliefs* are one of many types of mediating representations that is used in a cognitive process if and only if the belief is currently active (Hutner & Markman, 2016).

Significance of the Study

There have been varying opinions on the impact PBL has on student performance. Research has shown there was no difference in test scores between PBL students and traditional students at the undergraduate level (Alessio, 2004). Alessio's research also indicated there was a preference to the traditional means of instruction as opposed to the student-centered PBL instruction based on student responses. Research was also conducted which yielded results displaying students displeasure with PBL instruction (Lewis et al., 2009). Undergraduate student data suggests there was a lack of clear expectations from the faculty, student lead group sessions were unclear, and there was a lack of opportunity to explore personal academic interests (Lewis,

et. al, 2009). Research has also shown that PBL is an effective mode of instruction for undergraduate students based on assessment data. For example, non-science majors taking a biology course displayed significantly improved post-test scores when utilizing PBL and service learning components (Tawfik et al., 2013). PBL has also been shown to increase motivation and perception of students. Seventy-five percent of undergraduate students enrolled in an Analytical Chemistry course believed they worked more carefully than in traditional laboratory format (Robinson, 2013). The area that needs to be addressed or explored is pre-service teachers' beliefs of PBL when planning and eventually implementing during student teaching.

Based on the previously mentioned research, several local universities (including UNT) have adopted courses for preservice teachers based on PBL instruction. These courses are offered to education majors and focus on project-based and problem-based learning (brief description of one course is found in the appendix). As universities employ these practices based on the PBL concept, it is significant to understand the preservice teachers' perspective regarding planning and implementing PBL lessons in their future classrooms. Teachers that perceive themselves as facilitators prefer PBL as their primary means of instruction (Habók, 2016). Research has also shown an increase in pre-service teaches perception of their ability to effectively teach science through the use of PBL after undergoing an authentic PBL experience (Pepper, 2013). The research conducted by Habók and Pepper were valid analysis of teachers and future teachers' perspectives, but neither specifically focused on their participants' beliefs about planning and implementing PBL lessons.

Analyzing the impact PBL course instruction has on the actual transfer of practices to the classroom during student teaching would provide researchers and practitioners with knowledge of how to implement effective PBL instruction at the collegiate level more effectively. Research

has also shown that PBL methods could be beneficial to preservice teachers' content knowledge and increased knowledge of pedagogical techniques. (Ertmer et al., 2014). Problem-based learning has also displayed an increase in preservice teachers' perception of their confidence, self-efficacy, and problem-solving (Pepper, 2013; Parks & Ertmer, 2008; Ochoa et al., 2004). Despite an increase in the knowledge base created from the experience preservice teachers gain by participating in PBL based instruction, there are still questions regarding the actual planning and implementation in the classroom. According to So and Kim (2009), "this study shows that while student teachers had good understanding of pedagogical knowledge on PBL, they experienced several difficulties applying their knowledge into designing a PBL based, technology integrated lesson" (p. 111). Based on the literature there is a pellucid distinction that additional research is required in order to obtain a better understanding of how the positive experiences acquired in the university classrooms can be transferred to the classrooms. Analyzing "if" preservice teachers are actually implementing the practices acquired at the university could also lead into future research about "why" based on the results of this research.

Limitations to the Study

Despite the research reaching its aims, there were some unavoidable limitations that need to be acknowledged. First, because of the time limits and resources available, the pilot study was conducted on a population who were attending the summer training at the University of North Texas. In order to generalize for larger groups, the study should have included more students at different universities with similar courses. Second, the participants were novice teachers who volunteered to participate. Students that completed the course and elected not to participate may have a general disposition or philosophy regarding the implementation of a PBL curriculum in their classroom. Finally, the participants in-depth knowledge of PBL practices will play a vital

role in of the responses provided. However, the participants lack of knowledge of PBL practices could limit their responses which could negatively impact the qualitative and quantitative data collected.

Organization of the Study

This dissertation is composed of five chapters. The first chapter provides a basic introduction to the study and presents the significance of the study. Chapter 1 also presents the goals and aims, as well as, the purpose and research questions that are driving the research.

Chapter 2 provides a context for the research by examining the relevant literature on teachers' beliefs regarding implementing PBL in the classroom. The chapter offers background on PBL and is broken up into literature situated around preservice teachers' and novice teachers' beliefs regarding implementing PBL and PjBL.

Chapter 3 addresses the research method, data collection, and analysis techniques used in this study. It describes the design rationale and sampling methods utilized in this research.

Chapter 4 displays the results from the research. The results consist of qualitative data collected from focus groups and qualitative data collected from the questionnaire.

Chapter 5 analyzes and summarizes all the data collected and describes its significance to the research community. The limitations of the study and the ways in which this research can be improved or lead to other research topics is also covered.

In the following chapter, a review of the relevant literature is presented. The review is organized into the following sections: Definition of PBL and PjBL, Characteristics of Beliefs, Beliefs and Knowledge, Beliefs and Actions, Preservice Teachers' Beliefs, Teachers' Beliefs, Preservice Teachers' Beliefs about PBL

CHAPTER 2

LITERATURE REVIEW

Introduction

Understanding the best methods to prepare preservice teachers in an effort to ensure quality instruction is delivered has intrigued researchers since the 1970s (Clasen & Bowman, 1974; McCarney & Bullock, 1977). The studies conducted by Clasen and Bowman (1974) and McCarney and Bullock (1977) focused on student centeredness. However, the idea of teachers' beliefs emerged as the researchers were interested in determining how teachers viewed their effectiveness. These early studies opened the door for researchers to begin analyzing the vital role teacher beliefs play in planning and implementing instruction. Studies have found teacher beliefs are significant because they impact teacher behavior and expectations whether they are implicit or explicit actions (de Kraker-Pauw et al., 2016). Researchers have also found that sometimes beliefs do not drive actions or behavior, but the behavior or actions determine the teacher's beliefs (Dolphin & Tillotson, 2015). Regardless of the relationship, understanding teachers' beliefs is beneficial to comprehending the teaching and learning process.

Determining the significance of teacher beliefs on their effectiveness is an integral aspect of quality instruction, however, it is also important we understand the role novice teachers play in the teaching process. It would provide the University with data regarding the effectiveness of their classes for future educators. According to Stuart and Thurlow (2000),

> "novice teachers report that their undergraduate education programs inadequately prepare them to face the demands of teaching in classrooms with increased numbers of children who do not speak English; children with disabilities; children with inadequate family support for learning; and students who remain unmotivated to learn, disillusioned with their school progress, and alienated from the dominant school culture" (p. 113).

Based on the aforementioned research, it is clear to see the significance of the need to better

prepare preservice teachers for the challenging road ahead of them. The overwhelming challenges of today's classrooms have shown to directly correlate with teacher attrition rate (Ingersoll & Smith, 2003). According to Ingersoll and Smith (2003), "Around 39 percent of the participants (teachers) said that they left to pursue a better job or another career, and about 29 percent said that dissatisfaction with teaching as a career or with their specific job was a main reason for learning" (p. 32). In order to properly educate prospective teachers and prepare them to be agents of change in a status *quo system*, it is important to understand the beliefs that drive the decision making of these future educators.

The purpose of this study draws upon the literature regarding teacher beliefs about problem-based learning (PBL), specifically, the literature on novice teachers' beliefs about planning and implementing PBL curriculum. In this study, a clear and descriptive definition of "beliefs" will be admonished, the characteristics of beliefs will be discussed, the relationship between beliefs, knowledge, and behavior will be analyzed, and the literature will be reviewed regarding teachers beliefs related to PBL instruction and implementation.

Definition

Due to the complex nature in which beliefs are determined by the environmental settings and cognitive experiences (Jamalzadeh & Shahsavar, 2015), it is imperative that we establish a clear definition of the term. The ambiguity in the term belief has led researchers to describe the process of defining it as "messy constructs" (Pajares, 1992). In this study, teacher beliefs are defined as one of many types of mediating representations that is used in a cognitive process if and only if the belief is currently active (Hutner & Markman, 2016). This study subscribes to this definition of teacher belief for the following reasons: Firstly, this definition differs from other definitions because it incorporates the concepts of cognition and responsive actions which

cohere with the overarching research question for this study: "What is teachers' beliefs regarding planning and implementing PBL lessons?" In this case, preservice teachers' experiences from completing coursework correlated to PBL instruction would establish a social and cognitive construct to adequately prepare them for understanding PBL pedagogy.

Secondly, this definition focuses on the construction of aspects of 'reality' such as people, places, objects, events, cultural identities, and other abstract concepts (Goebell, 2011). Focusing on the reality of the concept provides clear conceptual comprehension as opposed to focusing on non-substantive notions such as values and perceptions (Richardson, 2013). For the purpose of this study, reality is the belief system and ideology of the prospective teachers. Thirdly, the definition subscribed to in this study does not specifically assume there is a correlation between beliefs and actions, but understands beliefs can impact behavior or actions (Hutner & Markman, 2016). This is significant because it explains that a preservice teacher does not necessarily have to believe in the effectiveness of PBL instruction in order to be an effective PBL facilitator. Some of the research utilized in this review does assume there is a direct correlation between beliefs and actions (de Kraker-Pauw et al., 2016; Kang, 2008) however, for the purpose of this study we will acknowledge beliefs can impact behavior and actions, but doesn't necessarily have to impact behavior and actions. This idea of the complex nature of teacher beliefs is reinforced by Bryan (2012) in the following statement:

> Regardless of the limitations or concerns about the definition of beliefs, we do know that beliefs are personal constructs that may provide an understanding of a teacher's practice, and the nature of that relationship, while not simple, is becoming better understood and described in science education research (p. 479).

Despite the messiness of the nature of defining teacher beliefs, there are some characteristics that are evident in beliefs.

Characteristics

Understanding what encompasses a belief is essential in understanding how a teachers' belief can impact their actions. To provide clarity on the concept of beliefs, understanding what constitutes a belief provides an insight into how we all possess ideologies which impact our actions daily. This attempt to comprehend beliefs will be aided by a clear depiction of the characteristics of beliefs. Bryan (2012) provided the following assumptions which characterize beliefs:

- Beliefs do not exist in complete independence of one another, but are structured into an "internal architecture" of systems that are psychologically, but not necessarily logically organized.
- Not all beliefs are of equal important to the individual. They are prioritized according to their relationship to other beliefs or other cognitive and affective structures.
- Beliefs are held along a continuum of centrality-some are more central, core, or primary, than others. It follows that the more central a belief is, the more resistant to change that belief will be.
- When a belief is changed, the centrality of that belief has repercussions for the entire belief system.
- Beliefs are far more influential than knowledge in discerning how individuals frame and organize tasks and problems and are stronger predictors of behavior (p. 478-479).

These characteristics acknowledge the idea that there is a convoluted connection between beliefs and actions. We also have to acknowledge that beliefs are variable and provisional. Cognitive scientists understand the fluid and messy means in which our beliefs are constructed and have had discussions regarding how beliefs are arranged in our brain (Nilsson, 2014). The best explanation of the usage of beliefs in this study and how emphasis will not be on interpreting how they are arranged in the brain is best explained by Nilsson (2014):

> Neuroscientists, psychologists, and philosophers continue to argue about whether there are any such sentence-like representations in our brains at all. For our purposes we won't worry about how beliefs are actually represented in the brain. Because we state them

> using sentences, it seems reasonable to think of them as sentences-constrained by the languages we use to construct them (p. 5).

Establishing a clear definition and identifying characteristics of teacher beliefs is essential in underpinning the epistemological basis of this study. Teacher beliefs are fluid and transformative constructing ideas that sometimes impact their actions. Despite having clearly identifiable characteristics of beliefs, it is also important to analyze the relationship which exists between beliefs and knowledge as well as behaviors or actions.

Beliefs and Knowledge

Determining whether knowledge and beliefs are separate is key to establishing the framework for understanding teacher beliefs. Some researchers consider beliefs as a type of knowledge (Nilsson, 2014). According to Nilsson, "knowledge represented by beliefs is called 'declarative' because beliefs are stated as declarative sentences" (p. 3). Nilsson also described procedural knowledge as a type of counter knowledge to declarative, however, for the purpose of this study, procedural knowledge will not be explored at this time. Other researchers suggest knowledge and beliefs are interchangeable and synonymous in meaning (Ennis, 1994). However, Kind (2014) distinguishes the difference between the two in the following sentences:

> Belief systems are nonconsensual: variability leads to researchers with common knowledge about a science topic teaching it differently. As beliefs are nonconsensual, there is no organized means of prompting change. Changing beliefs require a shift in thinking, not "just" an accumulation of further evidence. Contrastingly, knowledge is learned and held according to established procedures, resulting in consensus about how and what adjustments to make. Thus, while knowledge accumulates and adjusts systemically, beliefs are fixed, personal, and resist alteration (p. 125).

The description provided by Kind (2014) illustrates the notion that beliefs and knowledge are two entirely different concepts. For the purposes of the research on teacher beliefs regarding planning and implementing PBL instruction, this study will operate on the ideology that these two entities are separate. Separating these two ideas also provides a clear framework for

researching teaching beliefs and how these beliefs aren't a measure of knowledge. According to Pajares (1992), "beliefs have stronger affective and evaluative components than knowledge and that affect typically operates independently of the cognition associated with knowledge" (p. 309). Exploring the beliefs of preservice teachers regarding planning and implementing PBL would provide an opportunity to analyze the "stronger affective and evaluative components" described by Pajares.

Beliefs and Actions

Another component of teacher beliefs that will impact this study and must discussed is the impact of beliefs on actions. According to (de Kraker-Pauw et al., 2016), "the belief of teachers, whether implicit or explicit, is important because their impact on teachers' behavior and the expectations of their students" (p. 1). Humans act based on their fundamental belief system which is evident in religion, politics, and other social interactions. Research has found that teachers who possess beliefs which are aligned with a social constructivist ideology, utilize practices that enabled students to engage in student-directed, open-ended scientific inquiry projects in which students designed their own methods to design and assess knowledge claims (Bryan, 2011). The research conducted by Bryan is contradictory to the definition which was utilized to situate the framework of this research, however, it is important to include different perspectives to obtain an obtuse understanding of the impact beliefs have on actions.

The research conducted by Kang (2008) is more aligned with the conceptual understanding of the relationship between these ideas which will be utilized in this study. Kang (2008) found the following: Three patterns were discovered. 11 of 23 preservice teachers (PST) retained their initial epistemological beliefs and enacted these in teaching, seven developed and enacted beliefs different from their initial ones; and the remainder did not enact beliefs. The

results of the research conducted by Kang (2008), reinforces the concept of the messy construct nature of beliefs described by Parajes (1992). Despite reviewing literature describing a correlational relationship between beliefs and behavior or actions, this study will adhere to the working definition described in the introduction which does not correlate the two concepts.

Teachers' Beliefs

As the number of students at varying cognitive levels experiencing PBL instruction increases, there is a need to focus on preservice teachers that will potentially facilitate this pedagogical process. Understanding the best methods to prepare preservice teachers in order to deliver quality instruction to students is something that has been documented over the last forty years. Early investigations by the Division of Research positioned in the Office of Education, represent some of the earlier research regarding preservice and active teachers' competency in reference to content and instruction (McCarney & Bullock, 1977). According to the U.S. Department of Education Website, "While the agency's name and location within the Executive Branch have changed over the past 130 years, this early emphasis on getting information on what works in education to teachers and education policymakers continues down to the present day." This initial investigation opened the door for researchers to begin looking at various topics in the preservice teacher population. The initial areas of research focused primarily on instruction. Determining whether preservice teachers' actions and methods were student-centered or teacher-centered began an era of examining teacher perception that had not previously been analyzed (Clasen & Bowman, 1974).

Preservice Teachers' Beliefs

As researchers began looking into preservice teachers' beliefs, it provided a different insight into the methods of instruction utilized by universities. Preservice teachers' beliefs were

examined by Thomas Lasley and was documented in a 1980 article. Lasley (1980) found the following beliefs common amongst teacher education candidates:

(1) Teaching is a rewarding and fulfilling career;

(2) teacher education courses do little to prepare teachers for the real classroom;

(3) people who like children are effective teachers.

Lasley wasn't the only researcher interested in preservice teachers' beliefs. The impact teaching has on the teacher socialization process and found that what student teachers bring to their teaching experience gives direction to socialization but does not totally determine the outcome of the socialization process (Tabacbnick & Zeichner, 1984). Researchers proposed that the ideal time to study preservice teacher's beliefs were in the initial years of the program because of the state of flux that exists during this time in their educational development (Mayer & Goldsberry, 1987). Cooney (1985) found that a conflict existed between preservice teacher belief regarding methods in teaching problem solving skills and students' reception to his instruction methods.

As researchers began investigating preservice teachers' beliefs, different perspectives and topics were investigated. Some researchers proposed the idea that it is best to study teacher's beliefs within specific content (Peterson et al, 1987). This notion of content specific analysis of teachers' belief after the research was conducted by Peterson et al, (1987). Preservice teachers' knowledge and beliefs regarding reading instruction after participating in a fifth-year teacher education program was analyzed and found to provide preservice teachers with a voice in curriculum development at the university level (Hollingsworth, 1989). Carter and Lee (1989) provided information that was beneficial in designing quality preparation programs for health educators. Teachers' beliefs regarding their ability to understand mathematical computation skills was also studied during this time (Tirosh & Graeber, 1989). This research opened the door

to the current research and how the view of preservice teachers' perception is significant in regard to PBL.

Preservice Teachers' Beliefs about PBL

Pierce and Kalkman (2003) yielded one of the earlier studies that analyzed the impact preservice teachers' beliefs regarding students, learning, and teaching. Preservice teachers utilized PBL concepts based on LCP (Learner-centered principles). It was discovered there was a need to increase the amount of student-centered learning which occurs at the collegiate level. Researchers continued to explore the impact preservice teachers' beliefs had on instruction, however, the increase of PBL instruction at the K-12 level and the university was evident. Preservice teachers who experienced PBL instruction were able to describe curricular characteristics in a more student-centered way following treatment (Park & Ertmer, 2008). The increase in their ability to describe these characteristics is evident that PBL might be used to impact teachers' intended teaching practices. Ertmer et al. (2014) also collaborated with others to determine if integrating STEM (science, technology, engineering, mathematics) and PBL practices has the potential to simultaneously increase their knowledge in both pedagogies as well as their confidence in being effective teachers. Similar results occurred when preservice teachers incorporated service learning in two sections of a middle childhood, undergraduate, methods course (Harrison, 2013).

Technology also played a pivotal role in understanding PBL based instruction's impact on preservice teacher's beliefs. The results of these studies were not always positive. Some of the studies found the PBL process produced positive gains regarding preservice teachers' beliefs and content knowledge , but applying that knowledge to technology-integrated lessons was not that successful (So & Kim, 2009). Some researchers found that teacher's beliefs were not

impacted when providing instructions utilizing the PBL process (Berlin & White, 2010). Overall, it appears most preservice teachers experience a positive gain regarding how PBL instruction impacts their beliefs regarding instruction or implementation of new technology (Marshall et al., 2010; Blackbourn et al., 2008; Hoffer & Grandgenett, 2012; Edwards & Hammer, 2006).

The literature correlating teachers' beliefs regarding PBL instruction is not extensive. The researchers generally found preservice teachers possessed positive beliefs about the future implementation of PBL processes and projects in their perspective content areas (Ohn, 2013; Pepper, 2013). The limited data available specific to this area of research, is a sign that more research is needed in the area. Universities are including PBL courses in the curriculum as well as utilizing more PBL oriented instruction (Major & Palmer, 2001). The increase in preservice teachers' experience with PBL lends itself to be determined if the skills acquired are actually being implemented in the classroom. If preservice teacher are not implementing the PBL strategies learned, it would be beneficial to the university and K-12 education fields to know why this transfer of methodological practices doesn't exist.

Summary

The literature reviewed, so far, caused me to draw the following conclusions: (1) Beliefs are interdependent within a belief system, (2) teacher beliefs may or may not have a direct correlation with knowledge and actions, (3) teacher education programs can play a role in the shaping of teachers' beliefs about teaching and learning. The purpose of this study is to determine if a relationship exists between preservice teachers' beliefs regarding PBL and the implementation of a PBL curriculum. As the research is conducted, understanding the relationship between teacher beliefs, knowledge, and behavior will provide the framework for

designing and analyzing rich qualitative data. The analysis of this data provides a clear depiction of whether teacher beliefs impact teaching utilizing a PBL curriculum.

CHAPTER 3

METHODS

The aims of this research proposal were to: (1) create a questionnaire of teacher beliefs about PBL planning and implementation, (2) and based on the results of the questionnaire, describe teachers' beliefs that impact the planning and implementation of PBL. In order to complete these aims a qualitative design was utilized. Qualitative data was collected and analyzed in two phases. First, a science teacher and mathematics teacher focus group was used to identify themes associated with PBL planning and implementation. Secondly, a questionnaire, based on the identified themes, was developed and used to describe teacher beliefs about planning and implantation of PBL. This method provides increased understanding about how teachers who receive PBL as part of their preservice training, plan and use PBL practices once they become a teacher of record.

Design Rationale

Research has traditionally been conducted using quantitative or qualitative methods. Both of these methods of research can be linked to epistemological views that shape the strategies employed during the exploratory process. According to Browaeys (2004), epistemology is defined as a philosophical term meaning 'theory of knowledge' (p.2). The same concept is used by Creswell (2014), however he uses the term worldviews and defined it as a basic set of beliefs that guide action (p. 35). Regardless of the term used, it is evident the research practices are based on certain views that dictate the reasoning and practices that are employed.

Qualitative research focuses less on variable manipulation in isolation and attempts to uncover more in-depth understanding of the phenomena. Bryman (2008) best explains the

epistemology associated with qualitative research in the following sentences:

> Interpretivism is a term given to a contrasting epistemology to positivism. Interpretivism share a view that the subject matter of the social sciences-people and their institutions- is fundamentally different from that of the natural sciences. The study of the social world therefore requires a different logic of research procedure, one that reflects the distinctiveness of humans as against the natural order (p. 15).

This method of inquiry is best suited for addressing the research aims of this proposal. First, there was limited evidence informing measurement of teacher beliefs regarding PBL, specifically teachers' beliefs regarding the implementation of a PBL curriculum. Based on the limited evidence, there was a need for explorative qualitative work. Explorative qualitative research is generally employed when there is an unknown phenomena in distinctive contextual settings such as teachers' beliefs regarding PBL (Sofaer, 1999). Secondly, the need to test whether a relationship exists between teachers' beliefs regarding PBL and their implementing a PBL curriculum may be useful in generating knowledge to guide prospective teachers during preservice training.

Sampling

Sampling consisted of utilizing traditional purposive sampling techniques. According to Teddlie and Tashakkori (2009), "purposive sampling techniques involve selecting certain units or cases based on a specific purpose rather than randomly selecting" (p. 173). Often researchers utilize purposive sampling when they are interested in obtaining rich data from select constituencies (Valerio et al., 2016; Webster, 2016). Whether you are interested in a select group of nursing students (Webster, 2010) or interested in collecting data from a select population of people that are usually underrepresented, (Valerio et al., 2016) states that it is clear that purposeful sampling techniques are applicable too numerous diverse scenarios. Despite its diverse nature and ability to stretch across several research genres, there are some characteristics

that are consistent in all purposive sampling. Teddlie and Tashakkori (2009) provided the following characteristics of purposive sampling:

- Purposive sampling addresses specific purposes related to research questions; therefore, the researcher selects cases that are information rich in regard to those questions.
- Purposive samples are often selected using the expert judgement of researchers and informants.
- Purposive sampling procedures focus on the "depth" of information that can be generated by the individual cases.
- Purposive samples are typically small (usually 30 or fewer cases), but the specific sample size depends on the type of QUAL research being conducted and the research questions (p.173-174).

As the sampling occurs, it is essential that these characteristics are taken into consideration. The participants in this study were selected using traditional purposive sampling.

Participants

The population for the research consisted of mathematics and science teachers who were graduates of the Teach North Texas Program at the University of North Texas. The reason for including multiple content areas was to establish a large enough sampling to provide adequate data for generalization. The inservice teachers all have a degree in science or mathematics, and completed courses and field work leading to teacher certification. The education courses included a 45-hour course in PBL with significant field experiences that involved the development and implementation of PBL lessons in a PBL school. The focus of the PBL course is on the foundations, principles, and organization skills necessary to correctly facilitate project-based, case-based, and problem-based learning environments.

Data Collection

Focus Groups

Two focus groups were used in order to gain a better understanding of the in-service teachers' perceptions regarding the application of what they learned in the program, and how this knowledge was implemented in their classrooms as a teacher of record.

Focus groups are a form of group interview that capitalizes on communication between research and participants in order to generate data (Kitzinger, 1995). Focus groups have been traced back to Robert K. Merton who was a sociologist at Columbia University (Hesse-Biber & Leavy, 2011; George, 2013) and were used heavily in the 1960's and faded until the 1980's when its usage increased causing it to reemerge as a prominent method of conducting qualitative research in the academic arena (George, 2013). Data produced from focus groups are qualitative in nature and generally considered rich and descriptive (Hesse-Biber & Leavy, 2011).

Establishing focus groups of qualified participants provided extensive data regarding the teachers' beliefs. As am aim of this study is to determine if the graduates utilize the training from the PBL course when designing and implementing lessons in the field, themes developed from a focus group would be useful. According to Hesse-Biber and Leavy (2011), "focus groups have a distinct advantage over other available research methods when the researcher doesn't know all of the issues surrounding a topic" (p.163). The information from the focus groups produced data which was used to illuminate issues regarding implementation of PBL lessons in the field.

Interviews and Transcription

An interview of the focus groups was conducted in the initial phase of the research. According to Hesse-Biber and Leavy (2011), "focus group interviewing is not simply about interviewing several people at once but constitutes an entirely specific approach to research" (p. 164). Participants in the focus groups were selected because they possess some type of

experience of knowledge that could provide the researcher with insight on the research (Rabiee, 2004). The inservice teachers describe their personal experiences in the course and how or if they implemented these strategies as a teacher of record.

The data from the interviews was transcribed using a transcriber. According to McLellan, MacQueen, and Neidig (2003), "although there is no universal transcription format that would be adequate for all types of qualitative data collection approaches, settings, or theoretical frameworks, some practical considerations can help researchers prepare transcripts" (p. 64). To ensure the transcription process was valid and performed professionally, a transcriber approved by the University of North Texas was utilized. In preparation for the transcripts this study adhered to the following seven principles from Mergenthaler and Stinson (1992):

1. Preserve the morphologic naturalness of transcription. Keep word forms, the form of commentaries, and the use of punctuation as close as possible to speech presentation and consistent with what is typically acceptable in written text.

2. Preserve the naturalness of the transcript structure. Keep text clearly structured by speech markers (i.e., like printed versions of plays or movie scripts).

3. The transcript should be an exact reproduction. Generate a verbatim account. Do not prematurely reduce text.

4. The transcription rules should be universal. Make transcripts suitable for both human/researcher and computer use.

5. The transcription rules should be complete. Transcribers should require only these rules to prepare transcripts. Everyday language competence rather than specific knowledge (e.g., linguistic theories) should be required.

6. The transcription rules should be independent. Transcription standards should be independent of transcribers as well as understandable and applicable by researchers or third parties.

7. The transcription rules should be intellectually elegant. Keep rules limited in number, simple, and easy to learn. (p.129-130).

Sample

Focus Groups

Eleven participants were involved in the focus group interviews. Two separate interviews were conducted based on the teaching assignment (science or mathematics). The science focus group consisted of six (female), first- year teachers that completed the EDSE 4500 course and the math focus group consisted of five (1 male and 4 female) novice teachers who also completed a three SCH PBL course and implemented a PBL unit in a school-wide PBL classroom. The participants were graduates of the Teach North Text Program, and were participating in a summer content-specific professional development program on the University of North Texas campus. The summer professional development was designed and created for teacher graduates who had already completed the PBL course and were working in the field as teacher of record.

Questionnaire

The total number of participants who received the questionnaire was 138. Of the 138 questionnaires that were distributed, 96 participants responded. Figure 1 represents the participant demographics by ethnicity. Figure 3 represents the participant demographics by gender. Of the 96 participants, 91 responded and 5 opted out. The total number of completed surveys was 91. The total response rate was 70% (96/138) and the total completion rate was 95% (91/96). Of the 91 completed questionnaires, 58 (64%) did not utilize the techniques associated with project based learning.

Participants consisted of a variety of ethnic groups (n = 91). Forty-seven (51.65%) of the participants were White. The next largest ethnic representation in the study included 19 Hispanic participants (20.88%), followed by 9 Asian participants (9.89%) and 8 Black

participants (8.79%). The number of participants that did not report their ethnicity was eight participants (8.79%). The following graphs represents the participants ethnicity and gender (Figure 1 and Figure 2).

Figure 1

*Participant Demographics by Ethnicity (*N = *91)*

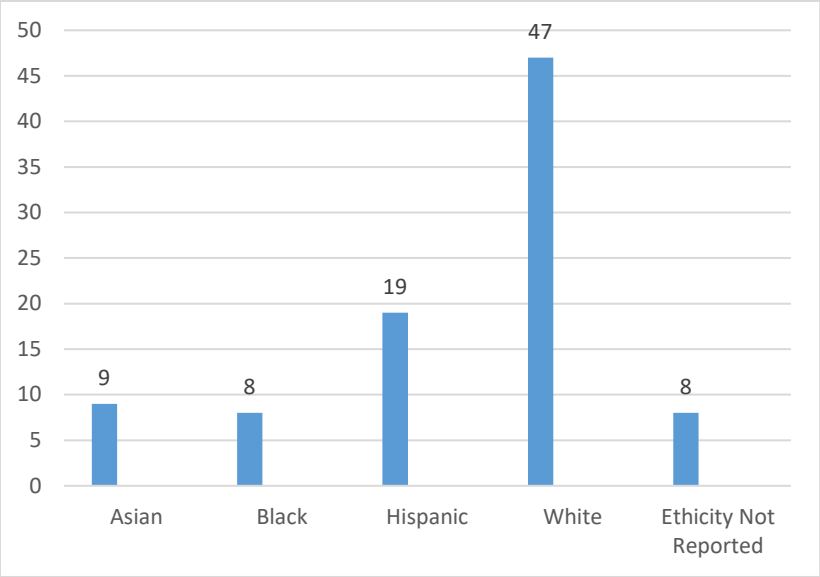
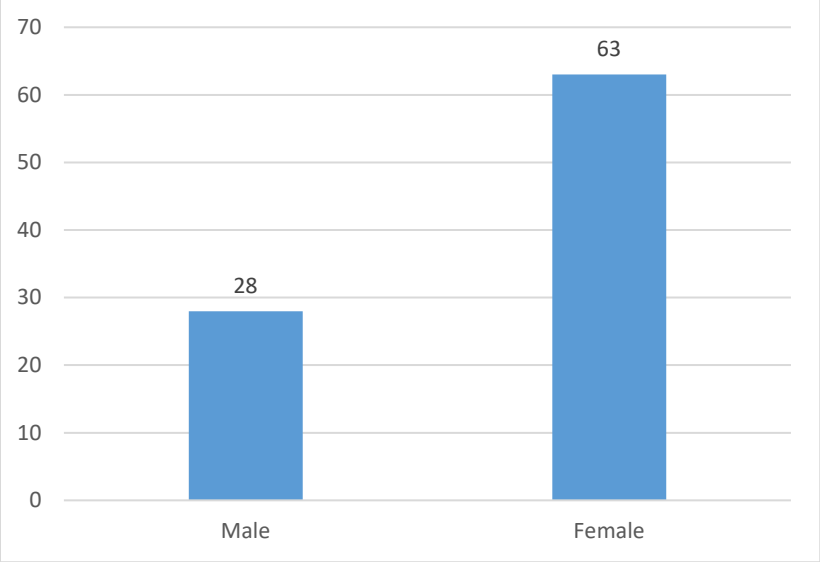


Figure 2

*Participant Demographics by Gender (*N = *91)*



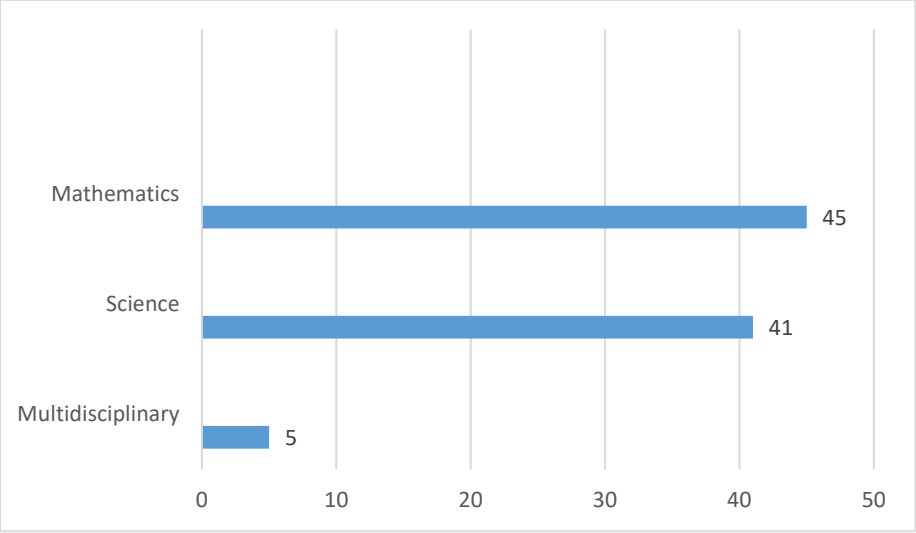
The participants were educators that specialized in the fields of science, mathematics, or multidisciplinary education. The data explaining participant teaching fields is in Figure 3. The terms, interdisciplinary and multidisciplinary are often used interchangeably. To establish clarity, distinguishing the difference between interdisciplinary and multidisciplinary instruction is necessary. Davidovitch and Dorot (2002) clearly discern the difference in these two methods of instruction in the following:

> While the multidisciplinary approach refers to combinations of disciplines, in which the distinct methodologies and assumptions of each discipline are maintained, the interdisciplinary approach concerns the crossing of traditional disciplinary boundaries (Klein, 1990) toward the creation of a new field shared by two or more bodies of knowledge. The aim of the interdisciplinary approach is to create a cognitive advantage that is not likely to be achieved through a disciplinary approach (Boix Mansillar & Duraising, 2007; Davidovitch & Soen, 2012).

Science and mathematics methodologies and each of their assumptions are generally maintained. Combined with the principle that a new field isn't being created when combining mathematics and science instruction, the term multidisciplinaryis used.

Figure 3

*Participant Content Area (*N = *91)*



Science and mathematics were the subjects that were taught and correlated with the science and mathematics focus groups. Both groups were almost equally represented. Forty-five (49.45%) participants were mathematics teachers and 41 (45.05%) were science teachers. The remaining 5 (5.49%) were multidisciplinary teachers. The total percentages are not equivalent to 100 % due to rounding. The self-reported teaching assignments suggest that teachers have infield placements that match the certification field.

A number of PBL practices were listed from which participants responded with the extent to which these practices were part of their PBL practices The data regarding the extent to which these strategies were used are displayed in Figure 4 (Question 6).

- *Use a rubric to guide or assess student work on projects*. Eighteen teachers (64.29%) almost always use a rubric to guide or assess student work on projects. Four teachers (22.22%) frequently used a rubric for assessment or guidance, and four teachers (22.22%) sometimes used a rubric. Two teachers (7.14%) rarely used rubrics, and there were no teachers who never used rubrics.

- *Have students reflect on the quality of the project, the work that went into it, or their learning*. Twelve teachers (42.86%) almost always had their students reflect on the quality of the project, the work that went into it, or on their learning. Six teachers (21.43%) used student reflection frequently and eight teachers (28.57%) rarely used it. There were no teachers that selected never as the frequency at which they used student reflective practices.

- *Have students answer questions about their work in front of an audience*. Seven teachers (25%) almost always had their students answer questions about their work in front of an audience. Seven teachers (25%) frequently allowed their students to explain their work in front of an audience and seven teachers (25%) sometimes allowed it. The remaining seven teachers

(25%) rarely allowed their students the opportunity to have their work questioned in front of an audience.

- *Develop a map of the project, a timeline, or a checklist to monitor progress*. Fourteen teachers (50%) almost always required their students to develop tools to monitor their progress. Six teachers (21.43%) frequently required students to develop self-monitoring tools and six teachers (21.43%) sometimes required it. Two teachers (7.14%) rarely required their students to develop self-monitoring tools and none of the teachers selected never to describe developing self-monitoring tools.

- *Assess content for accuracy, thoroughness, or depth of understanding*. Thirteen teachers (46.43%) almost always provided their students with an opportunity to assess their content. Ten teachers (35.71%) frequently allowed their students to assess the content they are learning. Three teachers (10.71%) selected sometimes to describe the frequency in which their students assessed the content learned. Two teachers (7.14%) rarely gave their students an opportunity to assess the content learned.

- *Require students to create knowledge, answering questions or solving problems that had not already been solved or answered*. Five teachers (17.86%) almost always required their students to create knowledge by answering questions or solving problems that had not already been solved or answered. Nine teachers (32.14%) frequently required their students to create knowledge by answering new questions and solving new problems. Six teachers (21.43%) sometimes required their students to create knowledge by answering questions or solving problems that had not already been solved or answered sometimes. Five teachers (17.86%) rarely required their students to create new knowledge, and three teachers (10.71%) never required them to create knowledge, answering questions or solving problems that had not already

been solved or answered.

- *Assess skills beyond academic content that students would demonstrate or learn*. Thirteen teachers (46.43%) almost always placed students in situations in which they were expected to assess skills beyond academic content. Seven teachers (25%) frequently expected their students to assess 21st century skills. One teacher (3.57%) expected their students to assess 21st century skills sometimes, and two teachers (7.14%) rarely expected their students to assess 21st century skills.

- *Specify content standards that projects were designed to meet*. Nineteen teachers (67.86%) almost always specified content standards that projects were designed to meet. Four teachers (14.29%) frequently specified content standards that projects were designed to meet. Two teachers (7.14%) sometimes specified content standards that projects were designed to meet, and three teachers (10.71%) rarely specified content standards that projects were designed to meet.

- *Use a driving question, essential question, or problem statement to focus the project.* Fifteen teachers (53.57%) almost always used a driving question, essential question, or problem statement to focus the project. Seven teachers (25%) frequently used one of the discussed practices to provide focus to the project. Four teachers (14.29%) sometimes used essential questions, or problem statements to focus the project, and two teachers (7.14%) rarely used them.

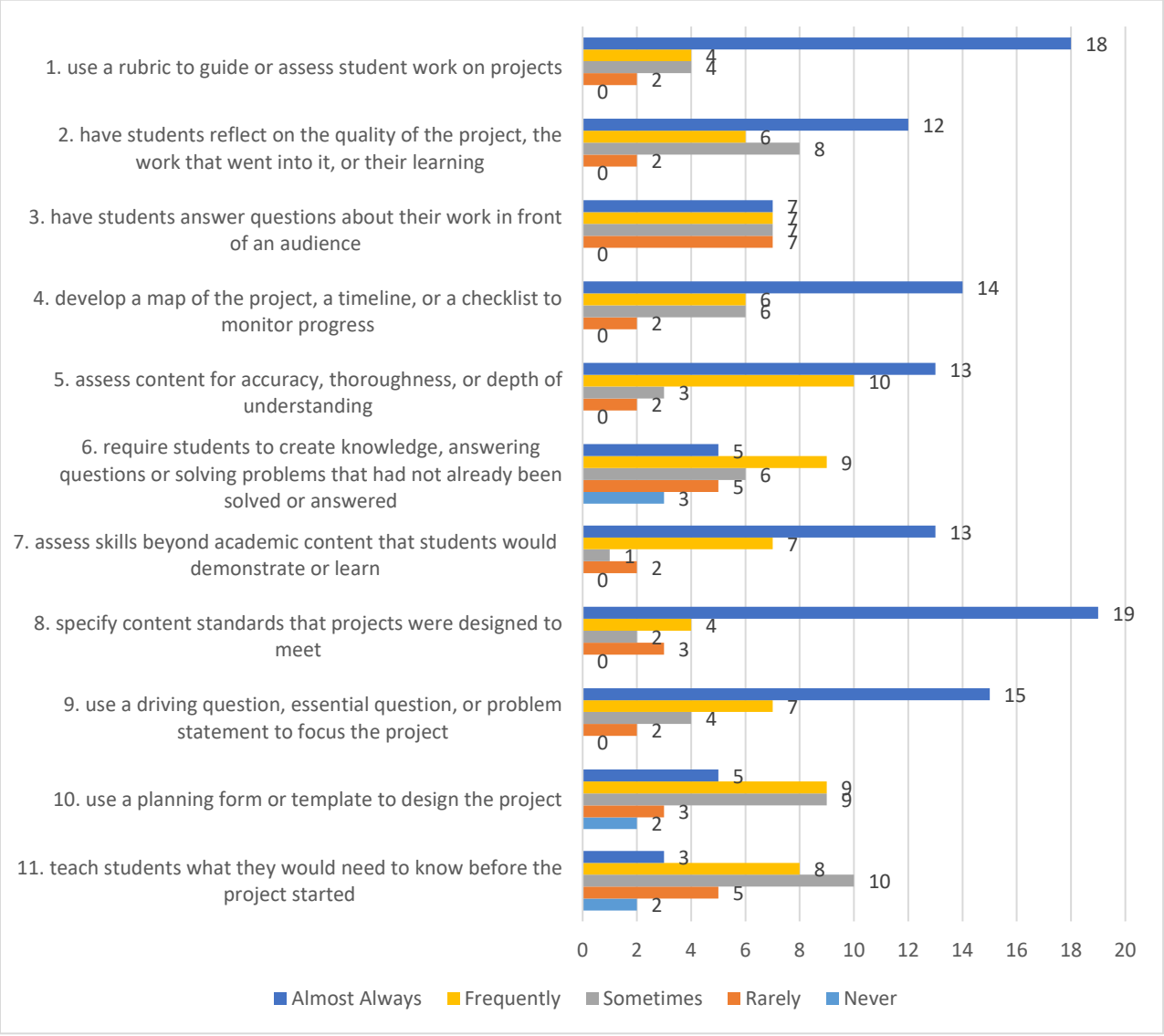
- *Use a planning form or template to design the project.* Five teachers (17.86%) almost always used a planning form or template to design the project. Nine teachers (32.14%) frequently used a planning tool to design the project, and nine teachers (32.14%) sometimes used one. Two teachers (7.14%) never used a planning tool when designing projects.

- *Teach students what they would need to know before the project started.* Three

teachers (10.71%) almost always taught students what was needed to know before the project started. Eight teachers (28.57%) frequently provided students with needed information before the project was given, and ten teachers (35.71%) sometimes provided the needed information. Five teachers (17.86%) rarely provided information that was needed for the project before beginning it, and two teachers (7.14%) never gave the information to the students before beginning a project.

Figure 4

*PBL Practices Frequency (*n = *28)*

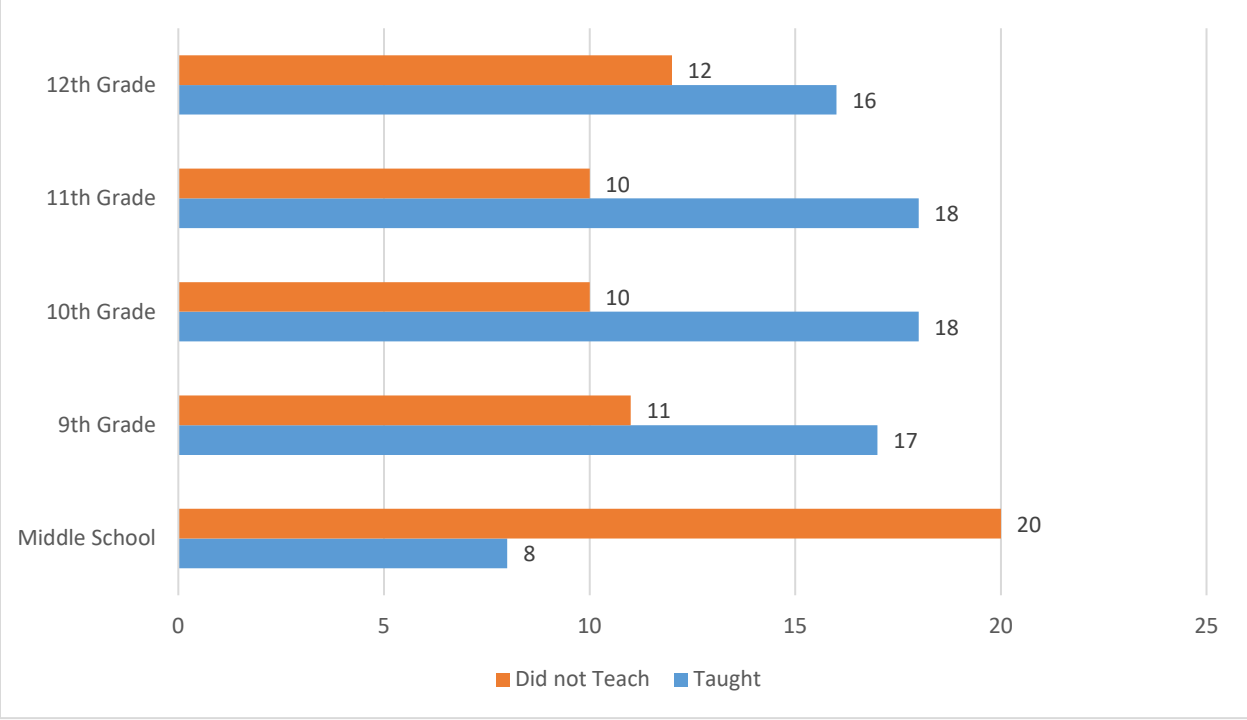


The grade-level demographics of the teachers that implement PBL practices in their classroom is shown in Figure 5. As shown, many teachers had assignments that included more than one grade level across their beginning years of their teaching career (Question 7).

A total of twenty teachers (71.43%) used PBL while teaching high school students (Question 8). Sixteen teachers (57.14%) were able to recall using PBL practices with students in the twelfth grade. Eighteen teachers (64.29%) used the same strategies in grades ten and eleven. Seventeen teachers (60.71%) had experience using PBL methods in a ninth-grade setting. Eight teachers (28.57%) had experience implementing PBL practices in middle school.

Figure 5

*Implementing PBL Practices by Grade Level (*n = *28)*

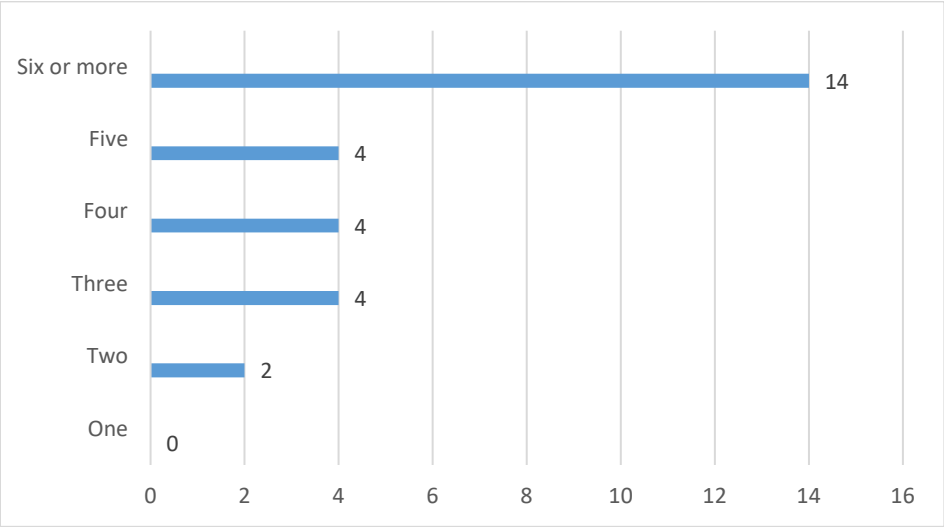


Fourteen teachers (50%) taught 6 or more different sections during the typical academic weak. Four teachers (14.29%) taught five sections. Four teachers (14.29%) taught four sections.

Four teachers (14.29%) taught three sections, and two teachers (7.14%) taught two sections during a typical week. The number of sections taught by a teaching is shown in Figure 6.

Figure 6

*Number of Sections Taught (*n = *28)*



Teacher comfort level regarding how well prepared they felt to do PBL related activities is described in Figure 7 (Question 10).

- *Assess students working in groups.* As shown in Figure 7, all of the teachers expressed the importance of assessing students working in groups. Eighteen teachers (64.29%) shared that they were well-prepared to assess students working in groups. Ten Teachers (35.71%) were somewhat prepared to assess students working in groups.

- *Teach and assess 21st century skills*. Collectively, teachers thought they were prepared to assess 21st century skills. Seventeen teachers (60.71%) indicated that they were well-prepared to teach and assess 21st century skills and eleven teachers (39.29%) were somewhat prepared to teach and assess 21st century skills.

- *Structure student presentations so whole class learns*. Nine teachers (32.14%) reported that they were well-prepared to structure students' presentations so the whole class

could learn. Nineteen teachers (67.86%) said that they were somewhat prepared to structure the students' presentations in a way that the entire classroom learns.

- *Facilitate and manage students' work in groups*. Eighteen teachers (64.29%) considered themselves well-prepared regarding the facilitation and management of students' work in groups. Ten teachers (35.71%) were somewhat prepared to facilitate and manage students' work in groups.

- *Promote depth or quality in student work during projects.* Fourteen teachers (50%) stated that they were well-prepared to promote depth or quality in student work during projects. Thirteen teachers (46.43%) described themselves as somewhat prepared to promote depth or quality in student work during projects. Promoting depth or quality in students' work during projects was not important or a goal of one teacher (3.57%).

- *Assess individual students' content learning using PBL*. Thirteen teachers (46.43%) expressed that they were well-prepared to assess individual students' learning using PBL. Fourteen teachers described themselves as somewhat prepared to assess learning and one teacher (3.57%) did not think they were prepared to assess individual students' content learning using PBL.

- *Meet state or district standards using PBL*. Fourteen teachers (50%) indicated that they were well-prepared to use PBL practices to meet state or district standards. Thirteen teachers (46.43%) were somewhat prepared to meet state or district standards by using PBL instruction. One teacher (3.57%) did not feel they were prepared to meet state or district standards when utilizing PBL practices in the classroom.

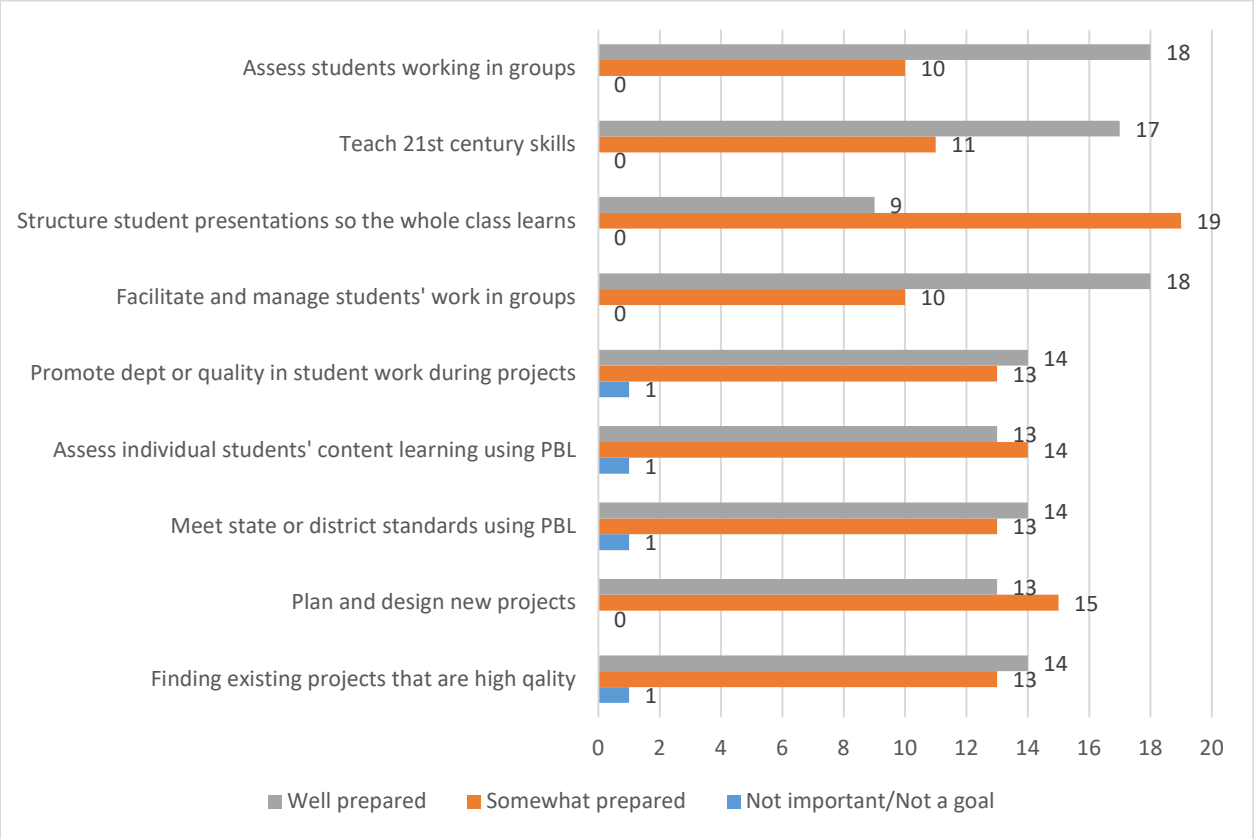
- *Plan and design new project*. Thirteen teachers (46.43%) reported that they were well-prepared to plan and design new projects. Fifteen teachers (53.57%) indicated they were

somewhat prepared and could plan and design new projects.

- *Finding existing projects that are high quality.* Fourteen teachers (50%) stated that they were well prepared to find existing high-quality projects for their students. Thirteen teachers (46.43%) were somewhat prepared at finding projects that are high-quality. One teacher (3.57%) was not prepared to find high-quality projects for their students.

Figure 7

*Teacher Preparedness (*n = *28)*

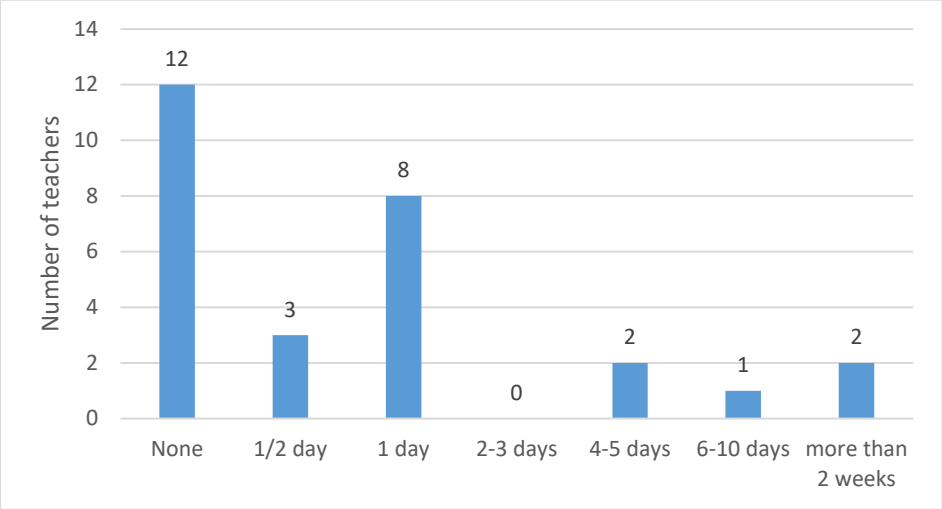


The next question centered around the amount of professional development teachers received that supported PBL. Participants were ask about professional development during their first year of teaching. Specifically, they were asked about how much total professional development supported the use of PBL including workshop days or part of days receiving coaching to implement PBL practices (Question 11).

Twelve teachers (42.86%) did not receive any PBL-related professional development. Eight teachers (28.57%) received about one day of PBL staff development and three teachers (10.71%) received half of that time in professional development. One teacher (3.57%) received six to ten days of PBL-related professional development. Two teachers (7.14%) received four to five days of PBL training and two teachers (7.14%) also received more than two weeks of PBL training. The data from the teachers' responses is shown in Figure 8.

Figure 8

*Professional Development (*n = *28)*



Data Analysis

Thematic Analysis

After the data from the interviews was collected, a thematic analysis was. According to (Taylor & Bogdan, 1984), "themes are defined as units derived from patterns such as 'conversation topics, vocabulary, recurring activities, meanings, feelings, or folk sayings and proverbs" (p.131). Thematic analysis provide the arena for themes to emerge from the rich data that is collected from the transcription of the focus group(s) interviews. Thematic analysis can be described as determining what "patterns" or "themes" emerge from the data (Braun & Clark,

2006). Braun and Clarke (2006) concluded the following phases are necessary for adequate thematic analysis: familiarizing yourself with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. It is important to note that the phases aren't required to be followed in a linear order that was previously listed, but instead utilized as a reflective and interchangeable process for analyzing data. The blueprint from Braun and Clarke provided the epistemological basis for analyzing the data and identification of emerging themes.

Questionnaire

A questionnaire was developed from the focus group themes. The response scale utilized verbal labels to reduce ambiguity in the translation of subjective responses and to clarify the meanings of the scale points. The questionnaire was piloted with three teachers and refined to improve context and clarity of the questions. This questionnaire was distributed to 138 program graduates of the Teach North Texas Program. The data collected from the questionnaire was used to provide a generalizable view of teachers' beliefs regarding PBL and utilizing PBL practices in their classroom while the teacher of record.

Summary

The aims of this paper were to: (1) create a questionnaire of teacher beliefs about PBL planning and implementation, (2) and based on the results of the questionnaire, describe teachers' beliefs that impact the planning and implementation of PBL. There is a need to get a better understanding of teachers' beliefs in regards to implementing a PBL curriculum. Universities are providing courses to better equip teachers with the challenges of today's classrooms. It will be beneficial to the university to determine if their efforts are actually translating to the classroom. Understanding what factors impact whether preservice teachers'

beliefs determine the actions they take in their future classrooms is beneficial to practitioners also. Overall, this study will provide insight for both collegiate and K-12 levels regarding teachers' beliefs about planning and implementing PBL.

CHAPTER 4

FINDINGS

This chapter contains the results of the exploratory sequential mixed methods study conducted to answer the following questions:

RQ1: What are novice teachers' beliefs about PBL while planning a lesson or unit?

RQ2: What are novice teachers' beliefs about implementing PBL lessons and/or units in their classroom?

This chapter provides a rationale for the analysis conducted which was consistent with exploratory sequential mixed methods methodology in light of the research questions. Additionally, this chapter includes teacher subject and grade-level demographics to provide context for the study. Data from two focus groups was used to analyze transcripts and develop codes and themes from the narrative. Multiple levels of analysis were utilized: (a) open coding, (b) axial coding, (c) thematic coding. At each level of analysis, data was constantly compared and reviewed until themes emerged from the codes. Results of the survey include tables and graphs in the discussion and to triangulate data from the focus groups. Lastly, this chapter will include tables and analysis of novice teachers' responses explaining teacher rationale and conditions for utilizing 21st century techniques in their perspective classrooms.

Data Analysis

There were two focus group interviews conducted with the novice teachers that completed the UNT course EDCI 4500, "Project-Based Instruction in Math, Science, and Computer Science." After the two focus groups interviews were conducted, the interviews were transcribed and subsequently analyzed, coded manually and reviewed for emerging themes by three science education experts. When differences in coding occurred, the experts reviewed the transcripts multiples times until consensus was reached. The researcher ensured thematic

analysis was properly applied to the research (Braun & Clarke, 2006).

Based on focus group transcripts, codes were identified. An example of the transcript codes is provided in Figure 5. The codes were then organized into table format that provided researchers with an opportunity to allow the themes to emerge. The tables displaying the codes from the transcripts are provided in Figures 6 and 7. After defining and naming the themes from the codes, survey questions were developed to correlate with the themes. An electronic survey was sent to 138 participants.

Themes began to emerge as focus group participants described whether they followed a district scope and sequence. A scope and sequence refer to the curriculum taught and the order in which it is delivered. According to Phenow (2018), "the information is placed in logical order in a scope and sequence to guarantee appropriate delivery of academic and media standards and to ensure that students do not miss out on important details in class" (p.10). Figure 9 describes whether the teachers perceived they had the autonomy to change their scope and sequence if necessary to properly implement PBL practices. The responses from the participants were separated by their specific content area and whether they had the flexibility to change their curriculum to employ PBL strategies. Each focus group participant was assigned an individual number and the data from the responses are shown in Table 2.

Table 2

Examples of Transcript Coding

Participant	Transcript	Code
Female 1	How are we doing it? STAR – I really think – actually it's the one thing I dislike about biology, is how obsessed we are with getting that perfect amount of every single thing, and it gets to an issue where if you wanna kind of go off track, and we do something kinda new, talk about CRISPR, the new in biology, or talk about maybe taxonomy right now, they're reordering the kingdom level, adding the super group, maybe..	Negative impact on State of Texas Academic Readiness examination (STAAR)

(table continues)

Participant	Transcript	Code
	And I find that a lot of times teachers who teach biology don't wanna do that because it's not TEKS.	Not aligned with Texas Essential Knowledge and Skills (TEKS)
Female 2	I've taught a regular biology classroom, which we really didn't do a lot of projects or pBL. I think it was mostly out of fear that the kids were not at the level where they could be successful.	Not for lower-performing students
	I have also taught a pre-AP class in which it was very project heavy throughout all units.	Works well for Pre-AP students
Female 1 (Geometry)	So they felt that they couldn't do any of these projects because they wouldn't have time to cover everything because we had so many days taken up with benchmarks and testing and practice for STAAR and whatever else.	Don't have enough time not for projects
		Not aligned with STAAR

Focus Group Response to Curriculum Planning

Focus group participants who utilized PBL practices shared the amount of time they actually committed to PBL instruction. There was a total of five teachers in the focus group that utilized PBL practices and shared feedback Table 3. Three (60%) of the teachers were science teachers and two (40%) were mathematics teachers. The data from their responses were able to be coded by time and content area. The codes that were identified are in Table 2, and we began to see the theme of inadequate time for planning emerge (Table 4).

Table 3

Focus Group Teachers' Ability to Choose Scope, Sequence, and Pacing of Content Taught

	Participant						
	1	2	3	4	5	6	7
Science	Not flexible	Flexible	Not flexible	Not flexible	Flexible	Not flexible	Not flexible
Math	Not flexible	Not flexible	Not flexible	Flexible	Not flexible	Flexible	Not flexible

Table 4

Focus Groups Response to Time-committed to PBL Instruction

	Participant			
	2	4	5	6
Science	Very project heavy in Pre-AP course		One unit out of the year	
Math		We make our own modifications based on what we feel is best for the students		25% of the time

Data Analysis

All interviews were transcribed. The researchers analyzed the two focus groups separately (i.e., science and mathematics). Separate analysis provided the opportunity to search for common themes and formed the basis for development of the survey questions. The survey consisted of an initial question to identify novice teachers utilizing PBL, followed by 13 questions examining how PBL was used in the classroom.

The number of participants for the follow-on 13 PBL questions decreased significantly because data was not collected from the 58 (63.73%) participants who did not utilize PBL practices. Of the 91 participants, 33 (36.26%) acknowledged that they, "do something like this and use the term PBL." Of the 33 participants that acknowledged PBL usage, 28 (30.77%) answered all questions and did not skip or leave responses blank. The responses of 5 participants were incomplete.

Question to Identify Novice Teachers Utilizing PBL

The first question addressed scheduling and had three parts. The total number of respondents for this question was 91. The results are shown in Figure 9. The results are

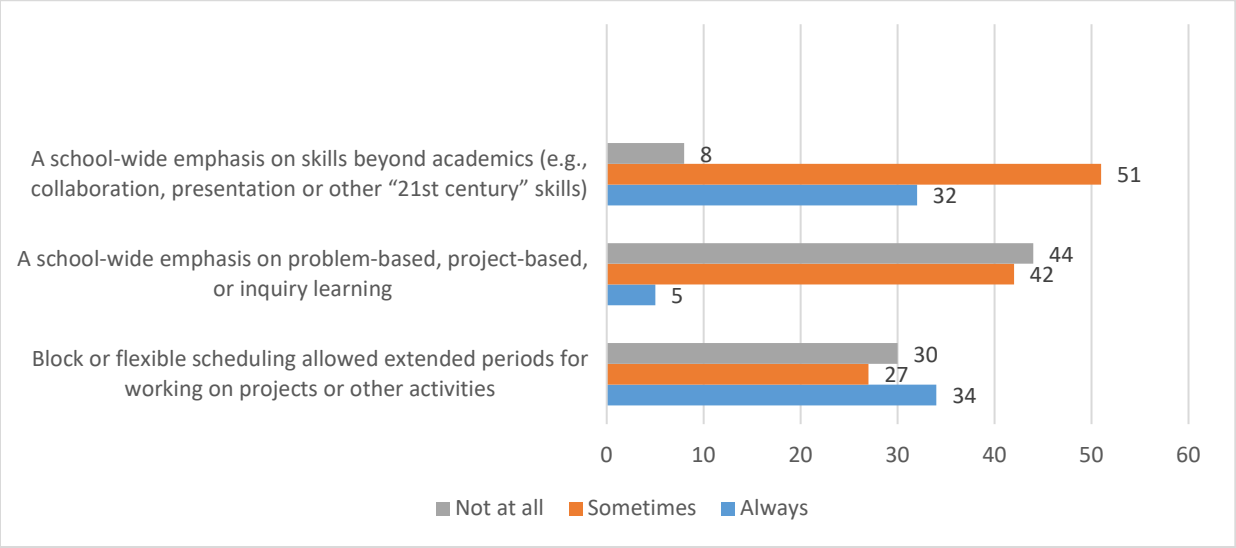
discussed below.

How often have you observed the following policies and procedures in place at your school?

1. *A school-wide emphasis on the 21st century skills*
2. *A school-wide emphasis on problem-based, project-based, or inquiry-based learning*
3. *Block or flexible scheduling allowed extended periods for working on projects and other activities*

Figure 9

*Campus Policies/Scheduling (*n = *91)*



- *Emphasis on skills beyond academics*. Thirty-two (35.16%) teachers expressed their campus "always" places emphasis on 21st century skills, 51 (56.04%) said their school "sometimes" places emphasis on 21st century skills. Only 8 (8.79%) teachers shared their school is not placing an emphasis on 21st century skills.

- *Emphasis on problem-based, project-based, or inquiry learning.* Five teachers (5.49%) worked in schools that "always" placed emphasis on project-based or inquiry learning. Forty-two (46.15%) teachers thought their schools "sometimes" placed emphasis on project-based or inquiry learning. Forty-four (48.35%) teachers expressed their school "does not" have a

school-wide emphasis on project-based learning.

- *Block or flexible scheduling*. Thirty-four (37.36%) teachers worked in an environment in which scheduling was "always" blocked or flexible enough to utilize PBL practices. Twenty-seven (29.67%) described their campus as an environment in which scheduling was "sometimes" blocked or flexible enough to utilize PBL practices, and 30 (32.96%) described their campus as not having a flexible schedule at all.

Procedures and policies that were not selected by the participants included: school-wide rubrics for assessing student work across different subjects, grades, or course, a grading and reporting system that included students' projects or portfolios, a structure supporting multi-age groupings of students, team teaching, teachers of different subjects assigned to the same course or group of students, senior or capstone projects for students to demonstrate readiness for the next grade or to graduate, or students all taking the same courses.

Survey Question 1

Question 1 describes the types of PBL projects and asked whether the participants' students were involved in any of the activities. There were a total of 15 activities. Of the 33 teachers that utilized project-based instruction, a total of 28 respondents provided detailed data regarding their usage of these activities. This is shown in Figure 10.

Question 1: Here are a few of the kinds of projects your students may have done. Were your students involved in any of the following activities?

1. *Interviewing family or community members or documenting their experiences or local history.*
2. *Creating and running a business or offering a service to the school or community.*
3. *Researching competing views on an issue and holding a debate.*
4. *Creating a museum-type display or exhibit for others to experience.*
5. *Researching an issue in the community in order to make recommendations or create a plan of action.*
6. *Developing a written product to be shared with others.*

7. *Developing artistic products or performances.*
8. *Constructing simulations, or models.*
9. *Making observations or collecting data.*
10. *Sharing data or interacting with students in other schools, professional experts, or outside organizations.*
11. *Developing relationships or working with people via the Internet.*
12. *Role-playing as a stakeholders to solve simulated problems based on the real world.*
13. *Writing a research paper.*
14. *Creating a working version of a physical object, structure, device, etc.*
15. *Creating a computer-based product or program.*

The activities that were less common included 9 teachers (32.14%) who provided opportunities for students to create and run a business which offer a service to the school or community or develop relationships or working with people via the internet. Only 11 teachers (39.29%) witnessed a student create a computer-based product or program.

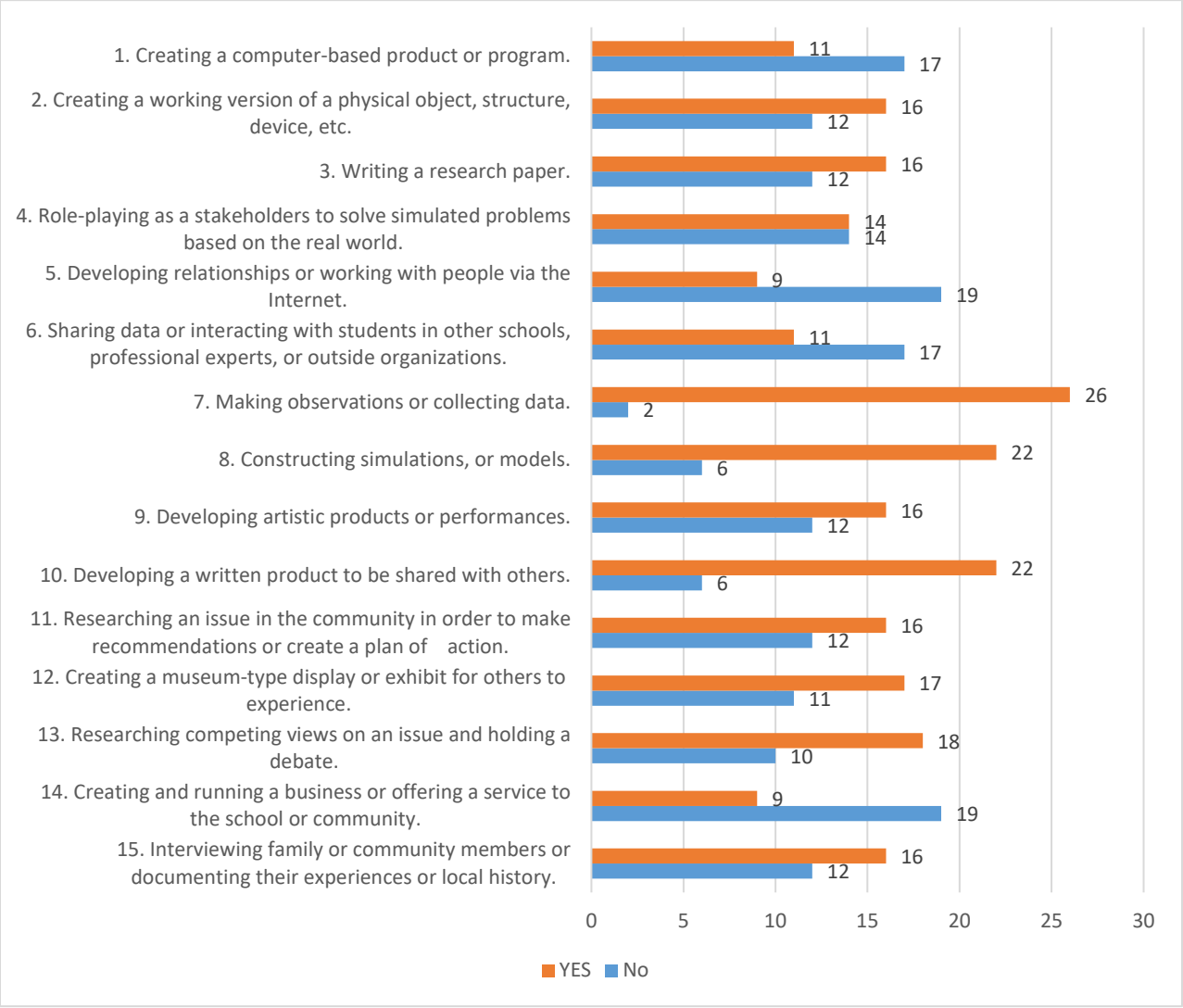
More commonly used activities associated with PBL were described by 16 teachers (57.14%) whose students developed artistic products or performances and interviewed family or community members or documented their experiences or local history. Fifty percent of teachers did not use role play for various stakeholders in order to solve simulated problems to explore real world challenges. Sixteen teachers (57.14%) provided students with an opportunity to research an issue in the community in order to make recommendations or create a plan of action to improve their community, wrote a research paper, and created a working version of a physical object, structure, or device. Seventeen (60.71%) teachers recalled students creating a museum-type display or exhibit.

The more commonly referenced activities included 18 teachers (64.29%) who reported their students researched competing views on an issue and held a debate. An opportunity to construct simulations or models and develop a written product such as posters, brochures, or letters to be sent to outside sources were noted by 22 teachers (78.57%). Although 26 (92.86%)

participants acknowledged their students made observations and collected data, only 11 teachers (39.29%) affording their students the opportunity to share presentations with students in other schools, professional experts, or outside organizations, failing to move to the action stage to advocate for needed change. Finally, 19 teachers (67.86%) who responded did not provide students with an opportunity to develop relationships or work with others outside of their school.

Figure 10

*PBL Activities Usage (*n = *28)*



Survey Question 2

Question 2 explored the participants' reasons for utilizing PBL strategies in their classrooms. There were six reasons listed, and respondents were given three options to select the impact the reasons had on their usage of PBL practices in their classroom (*not an important reason for me*, *a somewhat important reason for me*, and *an important reason for me*). The data from the respondents are displayed in Figure 11.

Question 2: Rate each of the following reasons for the use of PBL. I use PBL to …

1. *Promote students' international or cross-cultural understanding.*
2. *Make learning more personalized, tailored to students' individual interests or needs.*
3. *Promote students' civic engagement, contributions to the community or world.*
4. *Teach skills beyond academic content (group work, presentations, project management, 21st century skills, etc.*
5. *Teach academic content knowledge and skills more effectively.*
6. *Make teaching and learning more varied, challenging, or fun.*

- *Promote students' international or cross-cultural understanding*. Fifteen teachers (53.57%) thought promoting students' international or cross-cultural understanding was an important reason to use PBL practices. Eleven teachers (39.28%) thought it was somewhat of an important reason, and two teachers (7.14%) did not think it was an important reason.

- *Make learning more personalized, tailored to students' individual interests or needs.* Twenty-one teachers (75%) responded to making more learning more personalized, tailored to students' individual interests or needs as an important reason for them using PBL practices. Six teachers (21.43%) thought making learning more personalized was somewhat of an important reason for PBL usage. One teacher (3.57%) did not think making learning more personalized was an important reason for them utilizing PBL practices.

- *Promote students' civic engagement, contributions to the community or world.*

Twelve teachers (42.86%) shared and promoted students' civic engagement by contributing to the community or world was an important reason for them use PBL practices. Thirteen teachers (46.43%) thought promoting students' civic engagement was somewhat of an important reason to use PBL practices. Three teachers (10.71%) did not think promoting students' civic engagement by contributing to the community or world was an important reason for them utilizing PBL practices.

- *Teach skills beyond academic content (group work, presentations, project management, 21st century skills, etc.).* Twenty-three teachers (82.14%) expressed their belief that teaching skills beyond the academic content was an important reason for them using PBL practices. Four teachers (14.29%) selected somewhat important when asked if teaching skills beyond academic content was an important reason for their PBL usage. One teacher (3.57%) described teaching skills beyond the content area as not important for their reasoning for using PBL practices.

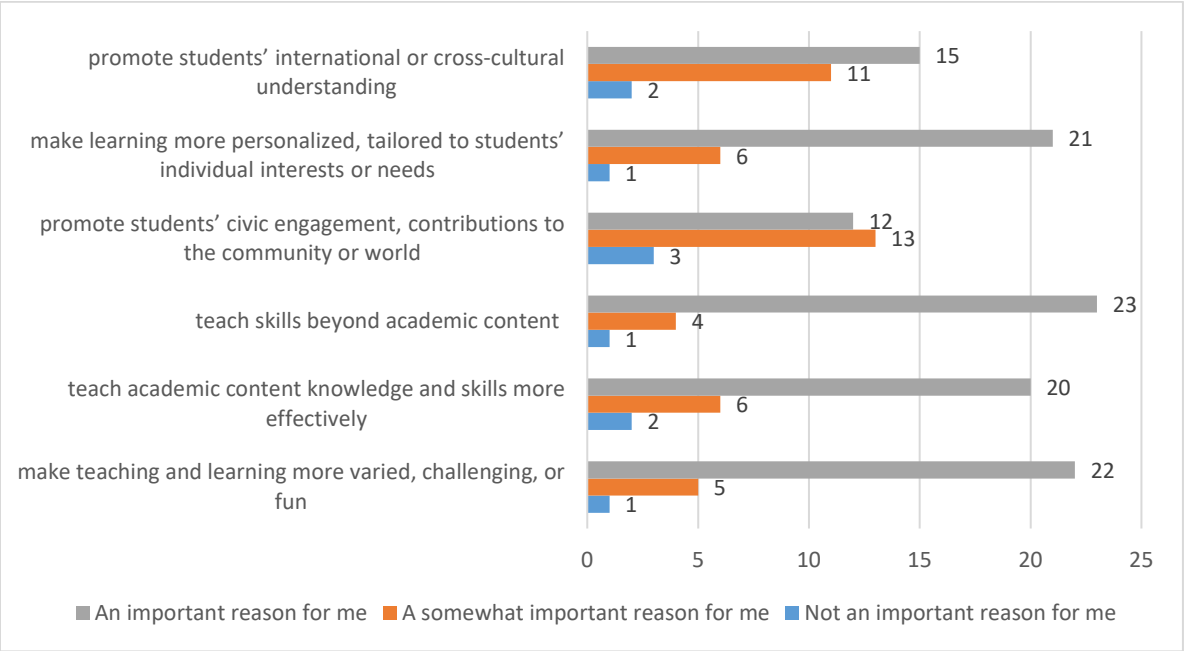
- *Teach academic content knowledge and skills more effectively.* Twenty teachers (71.42%) thought PBL instruction provided an opportunity to teach academic content area and skills more effectively. Six teachers (21.43%) described teaching more effectively as somewhat important. Two teachers (7.14%) did not think teaching more effectively was an important reason for their usage of PBL practices in the classroom.

- *Make teaching and learning more varied, challenging, or fun.* Twenty-three teachers (82.14%) listed making teaching and learning more varied, challenging, and fun as an important reason for using PBL strategies in their classrooms. Five teachers (17.86%) shared that making teaching and learning more varied, challenging, and fun was somewhat important for them when deciding to use PBL practices. One teacher (3.57%) did not believe that teaching and learning

more varied, challenging, and fun was a reason for their PBL usage.

Figure 11

*Reasons for PBL Usage (*n = *28)*



Survey Question 3

The third question focused on the teachers' perception of what type of students benefit most from PBL instruction. Teachers were asked to indicate their extent of agreement with this question using the following descriptors: *strongly disagree, tend to disagree, not sure, tend to agree,* and *strongly agree*. The data from this question is shown in Figure 12. A summary of the data for each category follows.

Question 3: To what extent do you agree or disagree that PBL is an effective teaching strategy for the following groups of kids? PBL is especially effective for...

1. *Students who struggle with academic English or have limited English skills*
2. *Students who tend to lack motivation*
3. *Low-achieving students*
4. *Average-achieving students*
5. *High-achieving students*

- *Students who struggle with academic English or have limited English skills.* As shown in Figure 12, results were mixed regarding teacher beliefs about English Language Learners. Ten teachers (35.71%) strongly agreed that PBL was an effective method of instruction for second language learners. Nine teachers (32.14%) tended to agree that PBL is effective with second language learners and four teachers (14.29%) were not sure if it was effective or not. Three teachers (10.71%) tended to disagreed with its effectiveness and two teachers (7.14%) strongly disagreed with its effectiveness.

- *Students who tend to lack motivation.* Teachers also were not consistent with regard to their perception of the impact PBL has on students that tend to lack motivation. As shown in Figure 12, eight teachers (28.57%) strongly agreed that PBL was an effective means of instructing kids who tend to lack motivation, and ten teachers (35.71%) tended to agree that it is effective. Four teachers (14.29%) were unsure of its effectiveness, while three teachers (10.71%) tended to disagree about its effectiveness. Three teachers (10.71%) strongly disagreed about the effectiveness of PBL as an instructional method for students who tend to lack motivation.

- *Low-achieving students.* Teachers expressed differing opinions regarding the use of PBL with low-achieving students. Ten teachers (35.71%) strongly agreed that PBL was effective for low-achieving students and eight teachers (28.57%) tended to agree. Two teachers (7.14%) were unsure of its effectiveness, while four teachers (14.29%) tended to disagree about its effectiveness. Four teachers strongly disagreed that this instructional method should be used with low-achieving students.

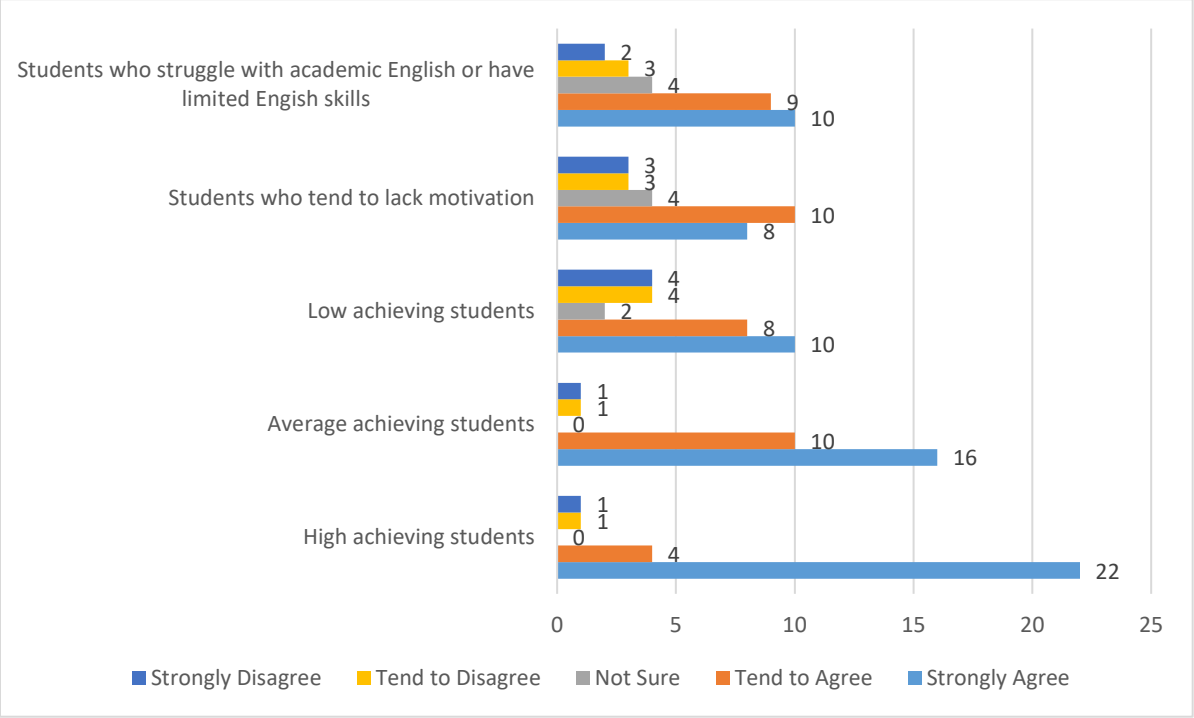
- *Average-achieving students.* When describing average achieving students, sixteen teachers (57.14%) strongly agreed it was effective and ten teachers (35.71%) tended to agree

with its effectiveness. There were no teachers who were unsure about the effectiveness of using PBL practices with average-achieving students. Only one teacher (3.57%) tended to disagree with using PBL with average-achieving students, and one teacher (3.57%) strongly disagreed.

- *High-achieving students.* Twenty-two teachers (78.57%) strongly agreed that PBL is most effective with high-achieving students and four teachers (14.28%) tended to agree that PBL is effective with high-achieving students. There were no teachers that were unsure about its effectiveness. Only one teacher (3.57%) tended to disagree with using PBL with high-achieving students, and one teacher (3.57%) strongly disagreed.

Figure 12

*Student Performance Levels (*n = *28)*



Survey Question 4

The fourth question addresses the frequency with which teachers utilized different teaching strategies. The results of the participants' responses are displayed in Figure 13 and a

narrative of the results follows.

Question 4: How often do you use the following teaching strategies in your classroom?

1. *Interdisciplinary projects, internships, or service learning*
2. *Team teaching with another teacher*
3. *A flexible approach to content depending on what students are doing*
4. *Direct instruction*

- *Interdisciplinary projects, internships, or service learning.* Opazo and Aramburuzabala (2019) defined service learning as "an experimental and pedagogical method that integrates community service and critical thinking with academic learning" (p. 154). Nine teachers (32.14%) shared they never used any of these practices in their classroom. Thirteen teachers (46.43%) sometimes used interdisciplinary projects, internships, or service learning. Four teachers (14.29%) selected about half the time and two teachers (7.14%) described using these practices most of the time. There were no teachers who used these practices all of the time.

- *Team teaching with another teacher.* Twelve teachers (42.86%) never team-taught. Thirteen teachers (46.43%) practiced team-teaching sometimes. Three teachers (10.71%) were in a position in which they co-taught or team-taught about half of the instructional day and there were no teachers that team taught most of the time or all of the time with another teacher.

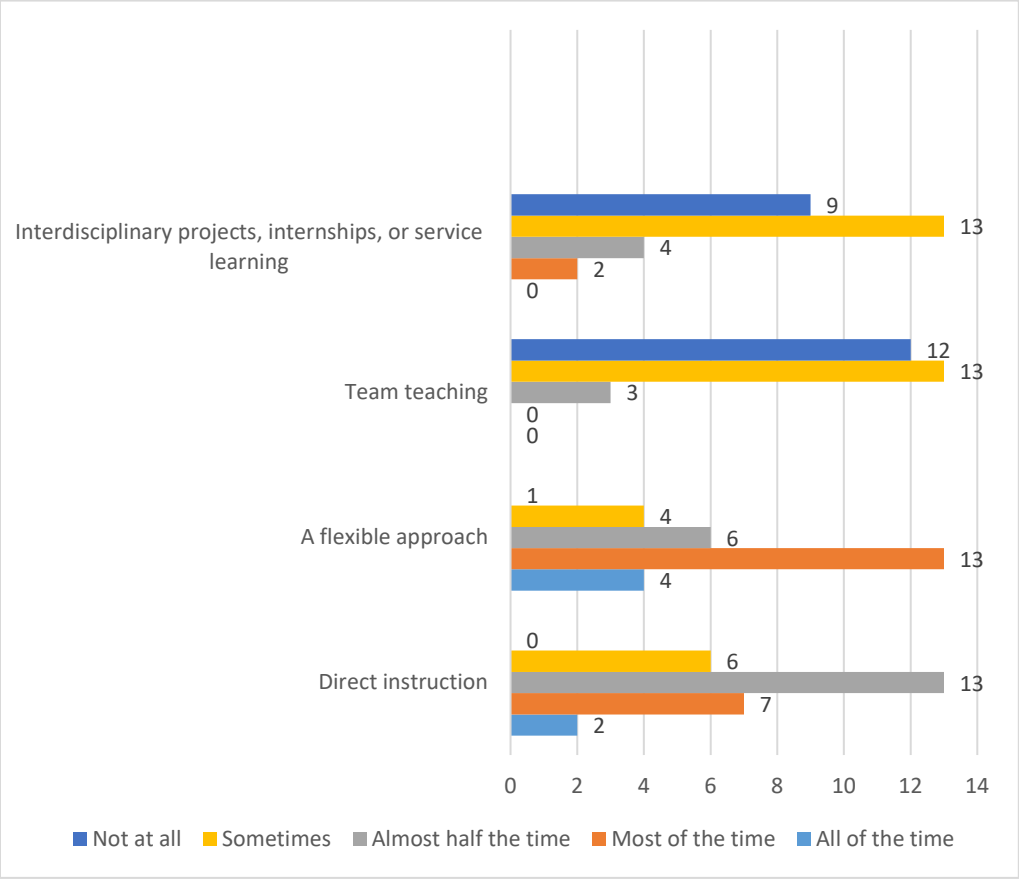
- *A flexible approach to content depending on what students are doing.* One teacher (3.57%) was never flexible with the curriculum. Four teachers (14.29%) sometimes used a flexible approach and xix teachers (21.43%) used the flexible approach half the time. Thirteen teachers (46.43%) employed a flexible approach to content learning depending on what students were doing most of the time. Four teachers (14.29%) were flexible with the curriculum all of the time.

- *Direct instruction.* Stockard (2020) clearly explains direct instruction as "a broad set of educational programs that incorporate elements of systemic or explicit instruction" (p.18).

There were no teachers who did not use direct instruction at some time. Six teachers (21.43%) sometimes used direct instruction. Thirteen teachers (46.43%) provided direct instruction almost half the time they were teaching. Seven teachers (25%) used direct instruction most of the time and two teachers (7.14%) use direct instruction as their primary and only means of instruction.

Figure 13

*Teaching Strategies (*n = *28)*



Survey Question 5

The fifth question provided more data regarding the content area in which the teachers provided instruction for their scholars. Figures 1 and 2 display the total data for everyone that was sent a survey, while Figure 14 displays the content demographics of the teachers that actually used PBL in their classroom. Fourteen teachers (50%) taught math, 11 teachers (39.29)

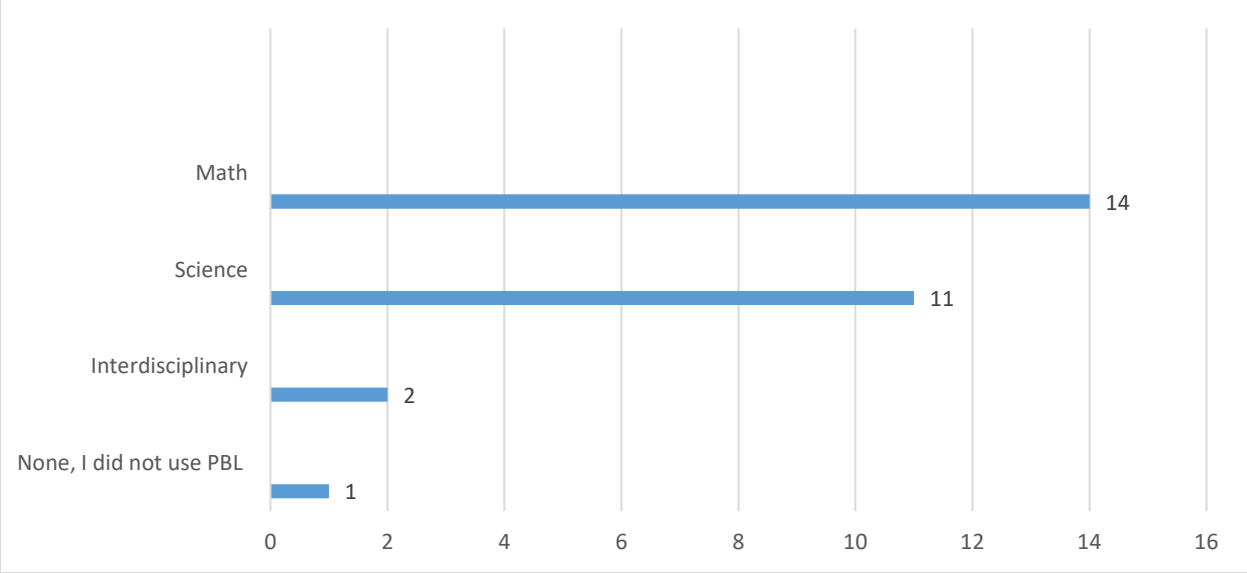
taught science, 2 teachers (7.14%) taught combined subjects, and one teacher stated she did not use PBL.

Question 5: In which of these core academic subjects do you teach? The projects I conducted/will conduct with my students are most often focused on…

1. *Math*
2. *Science*
3. *Interdisciplinary subjects, combined (e.g., math science)*
4. *None – I did not use PBL for any of these academic subjects*

Figure 14

*Participant Content Area (*n = *28)*



Survey Question 9

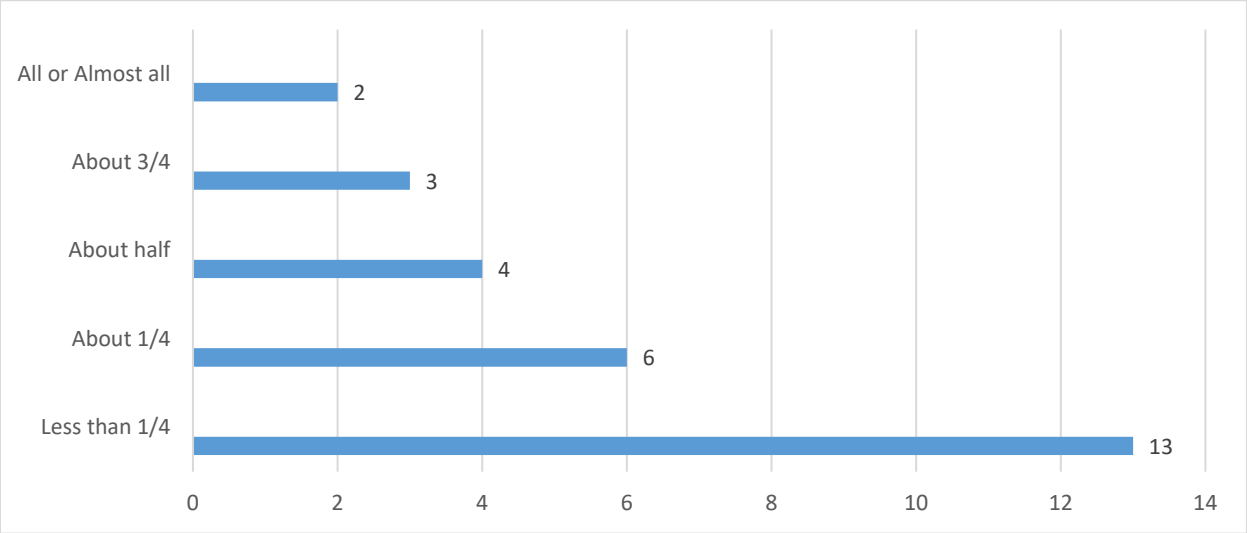
The ninth question addressed the amount of time students utilized PBL practices. Two teachers (7.14%) were in an environment in which students used PBL practices all or almost all of the instructional time. Three teachers (10.71%) instructed students to use PBL practices for about 75% of their instructional time. Four teachers (14.29%) used about half of their time for PBL instruction and six teachers (21.43%) used about 25% of their time for it. Thirteen teachers (46.43%) use less than 25% of their instructional time for PBL instruction. The amount of time

spent using PBL is shown in Figure 15.

> *Question 9: For a typical student in this course, about how much of the overall TIME was spent on PBL?*

Figure 15

*Percentage of Time Spent Using PBL (*n = *28)*



Survey Question 12

The final question explored the challenges that impacted teachers utilizing PBL practices. Teachers were able to share their beliefs regarding these different challenges and their impact on teaching using PBL practices. The data from these beliefs can be seen on Figure 16.

> *Question 12: To what extent were the following challenges that limited your use of PBL, or your sense of its effectiveness? Indicate how much of a challenge you perceived each to be.*
>
> 1. *Too many students or too large class size*
> 2. *Class periods are too short*
> 3. *Classroom space was limited*
> 4. *My students lacked experience or skills necessary in PBL*
> 5. *Students had poor attendance and/or behavior problems*
> 6. *Parents or students expected me to use direct instruction*
> 7. *Too many testing and accountability requirements*
> 8. *Lacks funds, materials, or resources*

9. *I lacked models or examples for using PBL in my subject area with my students*
10. *I lacked time to plan, create, or find quality projects*
11. *I lacked time in the curriculum to complete projects*
12. *I lacked professional development or coaching in PBL.*

- *I lacked professional development or coaching in PBL*. Two teachers (7.14%) said their lack of professional development or coaching was a major challenge. Six teachers (21.43%) considered their lack of professional development or coaching was a moderate challenge, and eight teachers (28.57%) considered it a minor challenge. Twelve teachers (42.86%) considered their lacking of professional development was not a challenge.

- *I lacked time in the curriculum to complete projects.* Twelve teachers (42.86%) thought the lack of time that is needed to complete projects was a major challenge. Four teachers (14.29%) thought the lack of time was a moderate challenge, and seven teachers (25%) thought it was a minor challenge. Five teachers (17.86%) indicated that a lack of time in the curriculum to complete projects was not a challenge.

- *I lacked time to plan, create, or find quality projects.* Five teachers (17.86%) said the lack of time to plan, create, or find quality projects was a major challenge. Nine teachers (32.14%) thought the lack of time to plan, create, or find quality projects was a moderate challenge, and nine teachers (32.14%) thought it was a minor challenge. Five teachers (17.86%) indicated it was not a challenge at all.

- *I lacked models or examples for using PBL in my subject area with my students.* Three teachers (10.71%) thought their lack of models or examples for using PBL was a major challenge. Six teachers (21.43%) considered their lack of models or examples for using PBL was a moderate challenge, and twelve teachers (42.86%) thought their lack of models or examples for using PBL was a minor challenge. Seven teachers (25%) stated the lack of models

or examples was not a challenge at all.

- *Lacks funds, materials, or resources.* Two teachers (7.14%) described lack of funds as a major challenge. Eight teachers (28.57%) considered the lack of resources, including funding, as a moderate challenge, seven teachers (25%) considered it a minor challenge. Eleven teachers (39.29%) stated that a lack of funds, materials, or resources was not a challenge.

- *Too many testing and accountability requirements.* Testing and accountability requirements also impacted teacher beliefs. Five teachers (17.86%) expressed that too many testing and accountability requirements was a major challenge to implementation of PBL. Six teachers (21.43%) though the large number of testing and accountability requirements was a moderate challenge, and ten teachers (35.71%) considered it a minor challenge. Seven teachers (25%) did not consider testing and accountability requirements a challenge to PBL implementation.

- *Parents or students expected me to use direct instruction.* Three teachers (10.71%) stated that parent or student expectations of direct instruction was a major challenge to implementing PBL practices. Five teachers (17.86%) stated parent or student expectations of direct instruction was a moderate challenge, and four teachers (14.29%) considered it a minor challenge. Sixteen teachers (57.14%) did not consider students and parents expecting them to teach using direct instruction a challenge.

- *Students had poor attendance and/or behavior problems.* Four teachers (14.29%) viewed poor attendance and behavior problems as a major challenge to implement PBL, and three teachers (10.71%) saw it as moderate challenge. Twelve teachers (42.86%) viewed poor attendance and behavior problems as a minor challenge, and nine teachers (32.14%) did not see it as a challenge.

- *My students lacked experience or skills necessary in PBL.* Twelve teachers (42.86%) thought their students lack of experience or skills necessary in PBL was a major challenge, and five teachers (17.86%) thought it was a moderate challenge. Eight teachers (28.57%) thought their students not possessing the experience and skills was a minor challenge, and three teachers (10.71%) did not think it was a challenge.

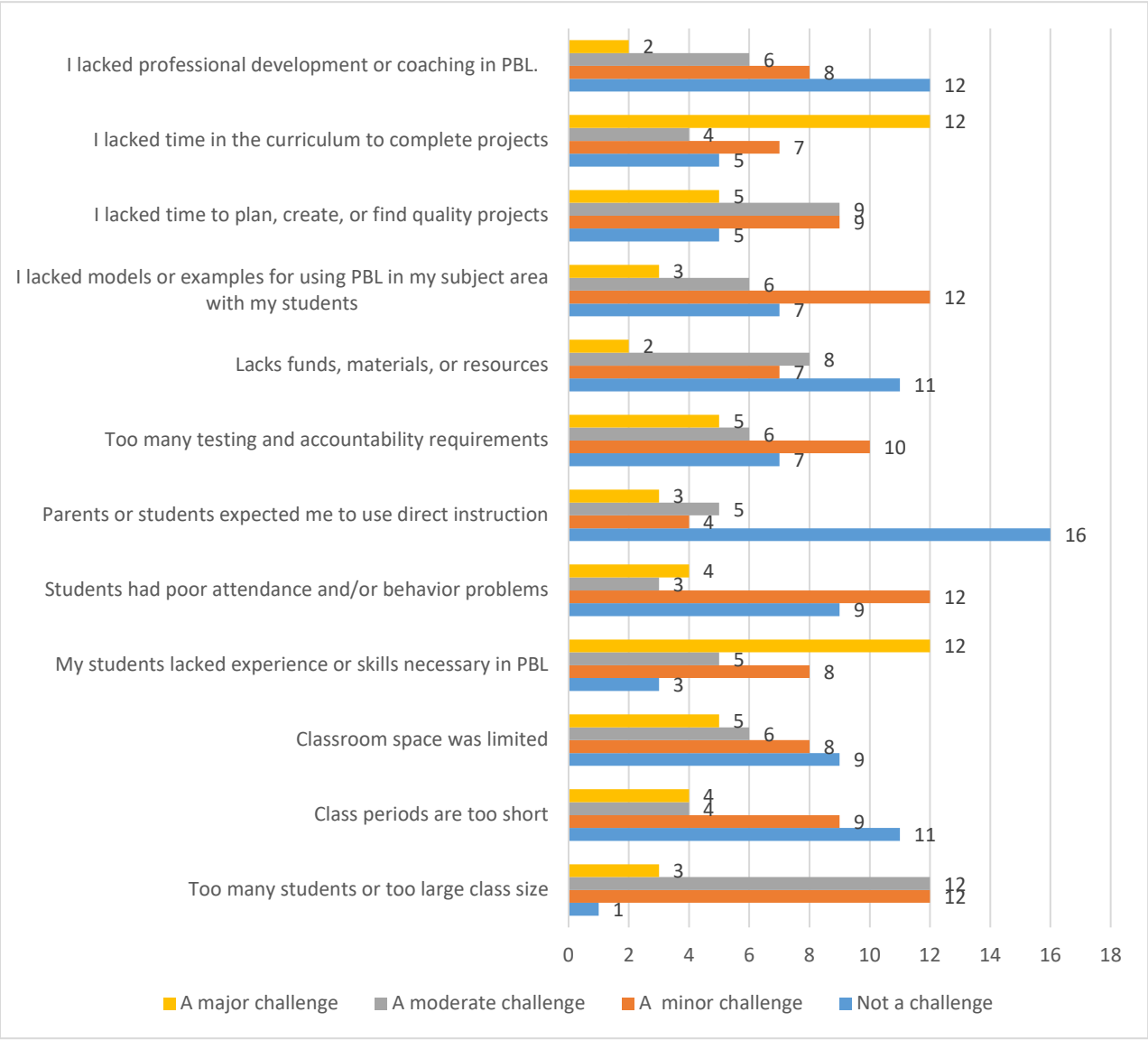
- *Classroom space was limited.* Five teachers (17.86%) stated that limited class space was a major challenge to utilizing PBL practices. Six teachers (21.43%) described limited classroom space as a moderate challenge, and eight teachers (28.57%) considered it a minor challenge. Nine teachers (32.14%) did not believe limited classroom space was a challenge.

- *Class periods are too short.* Four teachers (14.29%) described short class periods as a major challenge. Four teachers (14.29%) considered short class periods a moderate challenge, and nine teachers (32.14%) listed it as a minor challenge. Eleven teachers (39.29%) did not consider short class periods a challenge at all.

- *Too many students or too large class size.* Three teachers (10.71%) expressed too many students or large class size as a major challenge. Twelve teachers (42.86%) thought too many students or too large class size was a moderate challenge, and twelve teachers (42.86%) thought it was a minor challenge. One teacher (3.57%) did not consider too many students or too large class size as a challenge.

Figure 16

Challenges in Teaching PBL (n = *28)*



CHAPTER 5

CONCLUSION

The purpose of this exploratory sequential mixed-methods study was to describe how teachers use PBL when planning, designing, and implementing lessons. As part of their degree plan, all of the participants completed a PBL methods course and engaged in extensive field experience in PBL schools. This chapter includes a discussion of the major findings as related to the literature on teacher beliefs' regarding PBL and how their training impacted the planning and implementation of PBL strategies during instruction. Also included, is a discussion connecting constructivism to how teachers utilized PBL practices in their classroom. The chapter concludes with a brief summary, areas for future research, and a discussion of the limitations of the study.

This chapter contains discussion and future research possibilities to assist in answering the following research questions:

RQ1: What are novice teachers' beliefs about PBL while planning a lesson or unit?

RQ2: What are novice teachers' beliefs about implementing PBL lessons and/or units in their classroom?

The understanding of teacher beliefs regarding students learning utilizing PBL practices is situated in constructivist theory. According to Mamu, Nasar, and Ilyas, (2020), "the idea of constructivism has a summary of knowledge, namely: knowledge is not a mere picture of the world of reality, the subject forms schemes (cognitive, categories, concepts, and structures that need to be related to knowledge), and one's concepts will shape knowledge" (p.88). The two major forms of constructivism are cognitive and social. Cognitive constructivism focus on the individual attainment of knowledge and social constructivism focuses more on the impact of communication and interacting with others in knowledge acquisition. Teachers possess perceptions regarding how their students learn and the best methods to acquire that learning.

Some factors that impact the teachers' beliefs are personal experience, college training, staff development, or personal research. All of these factors help to contribute to teachers' beliefs regarding students' learning ability.

Interpretation of the Findings

While teachers possessed different backgrounds, experiences, and knowledge regarding PBL, there were common themes that were prominent factors shared by teachers interviewed and surveyed in this study. These themes from the pilot study manifested themselves and provided the framework for the survey that was distributed. To remain consistent with the results in this study, each question is summarized, analyzed, and suggestions for improvements as well as limitations are made based on the results.

Intitial Question to Identify Teachers Using PBL

Teachers were given the option to determine whether their schools had PBL practices in place at their school. There was a total of ninety-one respondents for this question (Figure 9). Only eight teachers (8.79%) expressed working on a campus where 21st century skills was not emphasized at all although the literature states the need for 21st century skills and acknowledges the school's role to adequately prepare students for these future challenges (Pearman, 2006).

According to the research conducted, 51 of the 91 teachers (56.04%) surveyed worked in an environment in which emphasis is "always" placed on 21st century skills development. However, that number significantly dropped to 5 teachers (5.49%) when asked if an emphasis was placed on PBL or PBL learning. The disconnect between PBL and 21st century skills could be attributed to those teachers being submerged in environments in which students are provided opportunities to collaborate, think critically, and present those findings to others without necessarily completing a project. It could also illuminate a larger problem which is that schools

are not aware of the correlation between 21st century skills and project-based instruction.

There was also a decrease from the number of teachers that worked in an environment that "always" placed an emphasis on 21st century skills to the number that always used blocked scheduling or were flexible enough to utilize PBL practices. According to Chen et al. (2020), "results of the research on the effectiveness of block scheduling have been mixed" (p.159). However, it would be difficult to acquire 21st century skills in an environment in which the schedule is not flexible. Approximately one-third of the teachers (n = 91) surveyed worked in schools in which block scheduling and other forms of flexible scheduling was not used. That is about 1/3 of teachers worked in schools in which a single period was less than 60 minutes in length.

The number of participants for the follow-on 13 PBL questions decreased significantly because data was not collected from the 58 (63.73%) participants who did not utilize PBL practices. Of the 91 participants, 33 (36.26%) acknowledged that they, "do something like this and use the term PBL." Of the 33 participants that acknowledged PBL usage, 28 (30.77%) answered all questions and did not skip or leave responses blank. The responses of 5 participants were incomplete.

Survey Question 1

Question 1 describes the types of PBL projects and asked whether the participants' students were involved in any of the activities. There were a total of 15 activities. Almost all of the teachers (92.85%) in this group provided students with an opportunity to make observations and collect data. There were also high percentages (78.57%) of teachers that placed students in situations in which they were required to develop a written product or construct models and/or simulations.

The two activities students were least likely to experience, were creating and running a business or offering a service to the school and community, and developing relationships or working with people via the Internet. According to the Buck Institute for Teaching (2021a), "the seven essential project design elements are: challenging problem or question, sustained inquiry, authenticity, student voice and choice, reflection, critique and revision, and public product."

Based on the results, while many teachers provide students with an opportunity to make observations and collect data, they do not encourage those students to share that information outside the classroom after it is collected. Teachers may stop after data collection because of time constraints. However, only completing portions of the process is not providing the students with the full PBL experience and they 21st century skill they will need to become effective citizens.

Survey Question 2

According to the results, and as shown in Figure 11, the three most common reasons teachers utilize PBL are: to teach skills beyond academic content (82.14%), to make teaching and learning more varied, challenging, or fun (78.57%), and to make learning more personalized, tailored to students' individual interests or needs (75%). According to Carrió, Rodríguez, and Baños (2020), " PBL provides an encouraging learning environment to develop generic research, and creative thinking skills, which have been identified as essential for facing 21st century challenges." Examples of 21st century skills include: problem solving, collaborative problem solving, communication, information literacy, and global citizenship as explained by Care, Griffin, and McGaw (2012). Teaching and learning 21st century skills is not just an American issue, it is a global issue that impacts everyone. However, three teachers (10.71%) did not think it was an important reason for PBL usage, while only twelve teachers (42.86%) thought it was an

important reason. Promoting civic engagement and contributions to the community or world is a significant part of the PBL process (Addler and Goggin, 2005). According to Adler and Goggin (2005), "Civic engagement refers to the ways in which citizens participate in the life of a community in order to improve conditions for others or to help shape the community's future" (p. 236). Based on the data, problem-solving (independently or collaboratively) is an important reason teachers utilize PBL strategies, but communication, information literacy, and global citizenship is not viewed as important. According to Julien, Gross, and Latham (2018), "information literacy is the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning."

Survey Question 3

The majority of the teachers, twenty-two (78.57%) strongly agreed that PBL is an effective means of instruction for high-achieving students as compared to ten teachers (35.71%) that strongly agreed it was an effective means of instruction for low-achieving students (Figure 12). Data regarding PBL and academic performance has varied. According to Ravitz, Hixson, English, and Megendoller (2012), 'classes with students, "at the expected level" had the fewest opportunities to learn these skills (21st century), with no difference between those who taught classes with students characterized as academically behind or ahead of most students.' Varying research has also shown that PBL is effective for students of different academic abilities. It has been found that PBL can show greater academic growth with low-achieving students as opposed to middle and high-achieving students (Han, Capraro, & Capraro, 2015).

Five teachers (17.86%) either strongly agreed or tended to agree that that PBL was not an effective means of teaching English language learners. Nineteen teachers (67.86%) tended to

agree or strongly agreed that PBL is an effective method of instruction. According to Othman and Shah (2013), "the PBL approach has had a positive impact on the students' language skills in the Cloze Test, as they performed better in the post test, despite receiving minimal instructions in the classroom" (p. 129). Adversely, it was discovered that PBL methods did not have a significant effect on low-level, English language learners because of their extensive dependency on their native tongue (Eguchi & Eguchi, 2006).

Research has also shown that PBL can positively affect English Language Learners attitudes towards learning (Putri, Artini, & Nitiasih, 2018). This finding is significant because six teachers (21.43%) expressed that they strongly agreed or tended to agree that PBL was not an effective means of instruction for students who lacked motivation towards learning. It has been found that the level of students' motivation can be increased by the facilitator of the project who encourages them to reach a deeper understanding of the material. (Harun et al., 2012). Eighteen teachers (64.29%) understood the positive impact PBL could have on students that lacked motivation towards learning.

Survey Question 4

The types of projects teachers described they implemented in their classrooms varied. There were no teachers who utilized interdisciplinary projects all of the time in their classroom and thirteen teachers (46.43%) sometimes used them (Figure 13). Only six teachers (21.43%) used interdisciplinary projects most or half of the time. According to Biasutti and El-Deghaidy, (2015), "interdisciplinary project-based learning (IPBL) offers a working framework and a motivating environment for students" (p. 340). IPBL also provides students with an opportunity to blend their ideas with others in an effort to create a specific project which connects aspects of different disciplines.

Team teaching is described as two or more teachers collaborating during the planning, implementing, or assessing of a class. (Baeten & Simmons, 2014). When this collaboration occurs with teachers from different disciplines, it is described as interdisciplinary team-teaching (Kodkanon, Pinit, & Murphy, 2018). Thirteen teachers (46.43%) indicated that they sometimes practiced team-teaching and three teachers (10.71%) practiced it about half of the instructional day. The remaining twelve teachers (42.86%) shared they never experienced team-teaching. In the real classroom, financial constraints complicates the possibility of teams working in a single discipline or as an interdisciplinary team.

Flexible instruction was another practice that yielded varying results from the participants. Texas schools usually follow a "scope and sequence" in which teachers are encouraged to follow the established district curriculum and pacing. Only four teachers (14.28%) expressed an ability to alter the district's scope and sequence all the time. The remaining fourteen teachers (85.72%) were able to alter the curriculum most of the time, some of the time, half the time, or none of the time. According to English (2013), "ample planning time, block or flexible classroom scheduling, a PBL-supportive curriculum, student access to technology, and common expectations for students are key components of a school-wide emphasis on PBL." Time is something that teachers in a test-driven curriculum have little control over. New teachers often feel obligated to follow the curriculum scope and sequence because of the fear of losing their job if students do not perform well on campus assessments, district benchmarks, and high-stakes testing. Those same results would likely have no consequences if the curriculum scope and sequence was followed.

According to Rosenshine (2008), there are five overlapping uses of the term direct instruction:

1. Academic instruction that is led by a teacher regardless of the quality of instruction.
2. The instructional procedures that were used by effective teachers in the teacher effects research.
3. Instructional procedures used by teachers when they taught cognitive strategies to students.
4. Instructional procedures used in the Distar (Direct Instruction Systems in Arithmetic and Reading) programs.
5. Instruction where direct instruction is portrayed in negative terms such as settings where the teacher lectures and the students sit passively

Despite the participants describing their instructional method as PBL, two teachers (7.14%) used direct instruction as their primary means of teaching and thirteen teachers (46.43%) utilized direct instruction as their primary means of lesson delivery almost half of the time. There were six teachers (21.43%) who sometimes used it, and seven teachers (25%) used it most of the time. Despite PBL modelling an inquiry-based approach, twenty participants (71.43%) continued to use direct instruction as their primary means of conveying information. This shows that teachers have a very nuanced idea about what the practice of PBL looks like in spite of their teacher training which involved a minimum of forty-five hours of instruction at the collegiate level and significant field experiences in PBL schools. This suggests that in addition to university training, teachers need additional professional development if they are to successfully practice PBL in the classroom.

Survey Question 5

Of the twenty-eight teachers who participated, fourteen were Math teachers and eleven were science teachers (Figure 14). The literature isn't conclusive regarding the effectiveness of PBL in the Math classroom. According to Jacques (2017), "there is not enough evidence that PBL in mathematics actually helps students to increase mathematical skills" (p. 430). Tillman

(2013) found that second grade mathematics students in the PBL setting experienced greater social growth as opposed to students in the traditional setting. Other researchers have found PBL to improve student motivation to learning mathematics concepts and skills (Filcik et al., 2012). Research has also shown that PBL may not be as effective in mathematics computation skills, but is significantly effective in the science and engineering classrooms (Chen &Yang, 2019).

Mathematics is assessed annually in Texas classrooms. This may explain the overuse of direct instruction by participants in this study as mathematics teachers represented 50% of the PBL teachers. This study contributes to the literature as the study of PBL by mathematics teachers represents a gap in the literature.

Eleven participants (39.29%) were science teachers. The research regarding the benefits of PBL and science are more robust than what is found in mathematics. In Texas, science is assessed once in elementary school, once in middle school, and once in high school as a Biology exam. It has been found that PBL instruction increased student performance on a 10^{th} grade science state assessment (Marx et al., 2004). Some researchers found that the means in which students are assessed is a significant factor in student learning. This translates as project based learning is more appropriate to authentic assessment, while traditional instruction is more appropriate to traditional assessment. (Parwati et al., 2019). It was also found that students who are traditionally labelled as low-achievement learners can experience success in science when curriculum alignment is accurate and professional development and district policies are in place to support the process (Marx et al., 2004).

Survey Question 6

Nineteen teachers (67.86%) specified that their projects were almost always designed to meet content standards (Figure 15). Despite the numerous hours spent by the university training

teachers in 21st century pedagogy, the role state standards play on all classroom teachers is evident. Research has shown that despite some teachers' openness and willingness to employ PBL practices into the classroom, the omission of a teacher's manual or an objective-driven lesson plan were concerns expressed even by veteran teachers (Mitchell et al., 2009).

According to Martínez et al. (2010), "rubrics are an excellent way to establish communication between the student and the teacher about the evaluation criteria and what the quality standard demanded by the teacher is" (p. 95). Two teachers (7.14%) rarely used rubrics in their classrooms, but twenty-six teachers (92.85%) used rubrics at a rate of sometimes, frequently, or almost always. Brodie and Gibbings (2009) stated, "rubrics should offer a positive view of every performance-level on the continuum focusing on what the student can do and offer helpful suggestions for improvement in each of the [rubric] categories." (p. 3).

There were no teachers who never used a driving question, essential question, or problem statement to focus the project (Figure 15). Fifteen teachers (53.57%) almost always used one, seven teachers (25%) used it frequently, four teachers (14.29%) sometimes used it, and two teachers (7.14%) used a problem statement or a driving/essential question for focus purposes. Driving questions are there for two entities, the teacher and the student. It helps the teacher initiate and focus the inquiry, and it creates interest and a feeling a challenge for the students (Miller, 2011).

Only seven teachers (25%) almost always provided their students with an opportunity to answer questions about their work in front of an audience. Seven teachers (25%) frequently gave them an opportunity to share, seven teachers (25%) sometimes and seven teachers (25%) rarely provided an opportunity to share. The Buck Institute of Learning lists the "public product" as one of the seven essential components of the Gold Standard of PBL. According to the Buck

Institute of Learning (2021a), "students make their project work public by sharing it with and explaining or presenting it to people beyond the classroom." One-fourth of the participants rarely provided the participants an opportunity to share their work missing a part of the process as described by the Buck Institute of Learning. It is unclear if the teachers do not understand the elements of the Gold Standards of PBL or they are purposefully omitting elements, perhaps due to lack of time.

Teachers were also inconsistent when describing students experiences regarding answering new questions or solving problems that had not already been solved or answered. Three teachers (10.71%) never required students to answer new questions or solving problems that had not already been solved or answered, and five teachers (17.86%) rarely engaged the students in this fashion. Solving or answering an "authentic" question is one of the essential components of the Gold Standard PBL as described by the Buck Institute of Learning. Almost one in three teachers failed to engage students in questioning as part of their PBL design.

According to the Buck Institute of Learning (2021a), "authenticity occurs when the project involves real-world context, tasks and tools, quality standards, or impact, or the project speaks to personal concerns, interests, and issues in the students' lives." According to Polman et al. (2018), "teachers frequently referenced authenticity as valuable to student learning" (p. 2). If eight teachers (28.57%) either never or rarely provided students an authentic experience, a significant aspect of the learning process is being omitted.

Twelve teachers (42.86%) almost always required their students reflect on their projects. Six teachers (21.43%) frequently required their students to reflect, eight teachers (28.57%) sometimes required student reflection, and two teachers (7.14%) rarely required students to reflect. Reflection is one of the gold standard PBL design principles. According to the Buck

Institute for Teaching (2021a), "students and teachers reflect on the learning, the effectiveness of their inquiry and project activities, the quality of student work, and obstacles that arise and strategies for overcoming them. Based on the results of this study, this represents another important principle associated with gold standard PBL design that is sometimes omitted. This omission supports the notion that teachers are not utilizing the entire PBL process as explained by the Buck Institute for Teaching, but rather have a nuanced view about implementation either due to lack of knowledge or deliberate choice to omit certain elements.

Survey Question 7

Teachers that participated in the research was from various grade levels (Figure 5). Almost two out three teachers taught in high schools and eight teachers (28.57%) taught in middle school. Seventeen teachers (60.71%) had experience teaching 9th grade. PBL has been found to have a positive impact on 9th grade students' perception of their attitudes towards mathematics when provided quality PBL instruction (Lee et al., 2019). Student and teacher attitudes are not the only aspects of education that has been impacted by PBL instruction. Research has also shown PBL students performed equally to traditional students in 11th grade science, 9th , 10th, and 11th grade mathematics, and performed better on 10th grade science state assessments (Craig & Marshall, 2019). The research listed correlates with the various grade levels that participated in this study.

Survey Question 8

Ideally a new teacher, should be given identical preps throughout the first year as the time intensive nature of PBL requires teachers to have an assignment of one section across the year (e.g., Biology) to allow them the opportunity to hone their PBL practice. Research has been conducted which describes the time-consuming nature of PBL. Time to plan with colleagues and

the time-consuming nature of project work in general were challenges shared by PBL teachers (Aksela & Haatainen, 2019). Fourteen teachers (50%) were responsible for six or more sections during the typical academic year (Figure 6). Four teachers (14.29%) equally were responsible for five, four, and three sections. Two teachers (7.14%) taught two sections. The researcher's personal experience with PBL included three sections of the same grade level that were two-hour blocks. The inquiry process and planning were time intensive. Block scheduling is better suited for PBL than 45 minute to 60 minutes class periods. Teachers with more than one classroom assignment (e.g., Biology and Chemistry) may have difficulties utilizing PBL.

Survey Question 9

Nineteen teachers (67.86%) spent one-fourth of their day or less utilizing PBL practices in their classroom (Figure 15). Based on the results, we can see the impact district scope and sequence curriculum guides has on classroom teachers' attitudes toward implementation of PBL. In this study, this correlates to the finding that 67.86% of the participants used traditional instructional methods for majority (3/4) of their instructional time. Teachers are faced with the fear of job loss and negative consequences if they do not follow the district scope and sequence with fidelity. Despite responding that they employ PBL strategies in their classrooms, the data shows that direct instruction predominates their teaching methods, not inquiring learning. According to the Buck Institute for Education (2021c), a difference exists between doing a project and participating in PBL. They elaborate on this difference by explaining that, "pbl requires critical thinking, problem solving, collaboration, and various forms of communication."

Survey Question 10

As shown in Figure 7, the three skills teachers shared they were most prepared to perform were: assessing students working in groups (64.29%), facilitating and managing students work in

groups (64.29%), and teaching 21st century skills (60.71%). Thirteen teachers (46.43%) considered themselves well-prepared to assess individual students' content learning in PBL as well as planning and designing new projects. Generally, participants felt well-prepared to teach PBL although direct instruction predominated their teaching methodology and only nine teachers (32.14%) were well-prepared to encourage their students to publicly share their products. As stated previously by the Buck Institute for Education (2021a), "students make their project work public by sharing it with and explaining or presenting it to people beyond the classroom." This is an important element missing from the participants' instructional design.

Teachers who participated in the study were provided forty-five hours of teacher training at UNT. They were also provided with one week of implementation of a unit they designed collaboratively with their peers (~30 hours), and were responsible for conducting field observations (~5 hours). Extensive feedback was given from university professors and field experience supervisors. In addition to one week of implementation, teachers field experiences were located at campus-wide PBL schools. Given their extensive experiences with PBL in authentic PBL settings, their lack of understanding and/or omission of elements critical to PBL practice is something that should be looked at more closely in the future.

Survey Question 11

Twenty-three teachers (82.14%) received one day or less professional development to further their PBL competency (Figure 8). Research has found that teachers who received extensive PBL training, taught 21st century skills more often and more extensively than teachers who did not (Hixson et al., 2012). Three teachers (10.71%) received four to ten days of training and two teachers (7.14%) received more than two weeks of training. The lack of professional development after leaving the university could attribute to teachers not utilizing PBL practices

that were taught at the university. The PBL practices that were taught at the university (~81 hours) were not always reinforced once participants became the teacher of record. This is evident in the responses to the survey and their lack of utilizing an authentic PBL practices with students.

Survey Question 12

As shown in Figure 16. the biggest major challenge was teachers lacking time in the curriculum to complete projects (42.86%). Time was not clearly defined to the participants but in education it can usually be associated with time needed to develop teachers, time needed to plan authentic projects, or time required for the natural inquiry process to occur. Aksela and Haatainen (2019) found that teachers felt they did not have enough time to effectively plan for PBL and complete the projects (p. 15). The predominate style of traditional teaching that was evident in this data could be associated with teachers' beliefs that traditional learning requires less time than inquiry and information can be transferred at a faster rate.

Twelve teachers (42.86%) responded that their students lack of the necessary experiences or skills to successfully complete PBL projects was a major challenge. Almost half of the participants believe students should possess certain academic skills before engaging in the PBL process. Han et al. (2015) found greater academic growth in low-achieving students as opposed to middle and high-achieving students. Research by Othman and Shah (2013) found PBL had a positive impact on the second language learners' language skills. As we can see by the research, PBL has had a positive impact on learners that would be normally considered lacking in academic skills. The participants belief that a certain existing skillset is required in order to reap the academic reward of learning via PBL could be a contributing factor to the dominate usage of direct instruction.

Limitations of the Study

Some of the questions in the survey were generalized to increase the number of responses in the range of questions. These questions could be improved by assigning an exact numerical value for each response. The categories were adequate to understand the generalizations of the question, but a numerical value would have provided greater clarity.

The PBL activities were derived from the focus group interviews and suggestions from the Buck Institute for Education. To improve the PBL activities questions, I would add one or two activities that are not necessarily PBL activities. These activities would serve as outliers and assist in determining if the participants clearly understand PBL-based activities. This study could be improved by examining the mathematics and science teachers separately. The reason for combining the subjects was to increase the number of participants in the study which would have been small due to the discipline that was being studied.

The predominate use of direct instruction instead of sustained inquiry should be further investigated. The twenty-eight teachers in this study indicated they are practicing PBL, however PBL Gold Standard Elements are missing including; public product, authenticity, voice and choice, and sustained inquiry. Once becoming teaching of record, field observations with debriefing could be used to determine if these elements are purposefully omitted or if the participant has a lack of understanding about PBL design and practice.

Finally, the inclusion of case studies alongside the survey would provide additional insight into the participants' thinking. This would provide the opportunity to document PBL practices in the classroom and to more fully explore the participants' understanding of PBL design and practice.

Implications

If we are to improve teachers' use of PBL planning and implementation, we must focus on not only teacher training and the associated field experiences. It is also important to connect what they have learned as preservice teachers to implementation with students in today's classrooms after they become the teacher of record. It is imperative that schools take responsibility for honing this knowledge which helps students better prepare for 21st century challenges. Schools should offer content specific professional development which helps teachers plan and design PBL projects that are aligned with standards. Such professional development should be offered throughout the academic year. Additionally, the professional development should be collaborative in nature and offer teachers the opportunity to speak freely about the challenges and rewards of using PBL.

The predominate use of direct instruction instead of sustained inquiry should be further investigated. The twenty-eight teachers in this study indicated they are practicing PBL, however PBL Gold Standard Elements are missing including; public product, authenticity, voice and choice, and sustained inquiry. Once becoming teaching of record, field observations with debriefing could be used to determine if these elements are purposefully omitted or the participant has a lack of understanding about PBL design and practice. Given that preservice teachers are novices in all aspects of classroom teaching, they will need additional mentoring and support as they plan and implement PBL practices, and until they become familiar and confident in using them.

APPENDIX

DESCRIPTION OF EDCI 4500

Title of class:- Project-Based Instruction in Math, Science and Computer Science

Credit hours: 3 hours

Foundations of project-based, case-based and problem-based learning environments. Principles of project-based curriculum development in mathematics and science education. Classroom management and organization of project-based learning classrooms. This capstone course should be taken just prior to student teaching.

http://catalog.unt.edu/search_advanced.php?cur_cat_oid=20&search_database=Search&search_db=Search&cpage=1&ecpage=1&ppage=1&spage=1&tpage=1&location=3&filter%5Bkeyword%5D=edci

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